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Animals' fear of humans after the Flood

UPPER MESOPOTAMIAN
LOCATION FOR BABEL

NEANDERTHALS COULD
HEAR LIKE MODERN MAN

DO THE 'WATERS ABOVE'
SURROUND ALL GALAXIES?

INFANT GRASP REFLEX:
EVIDENCE OF APE ANCESTRY?

JOURNAL OF CREATION

An international journal devoted to the presentation and discussion of technical aspects of the sciences such as geology, biology, astronomy, etc., and also geography, archaeology, biblical history, philosophy, etc., as they relate to the study of biblical creation and Noah's Flood.

COVER: Young wild fox

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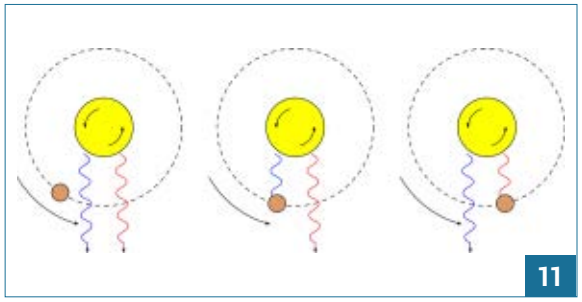

Although a challenge to planetary scientists, the 'misaligned' orbits of extrasolar planets point to God's creativity and power.

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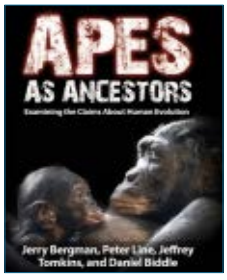

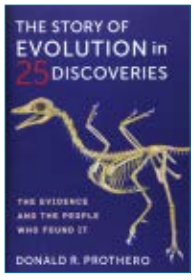

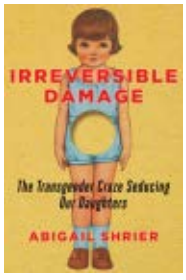

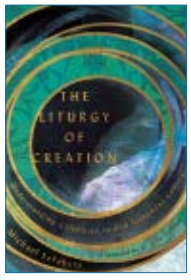

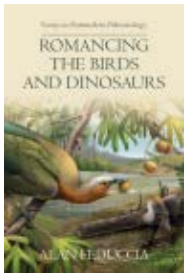

VIEWPOINT

ESSAYS

Was Horus, the pagan Egyptians falcon sun-god, a deification of Noah's third son, Ham?

PAPERS

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Passive margins explained by Flood runoff

Michael J. Oard

Passive margins are offshore continental margins not associated with an active plate margin. Instead, they are a shallow continental shelf that dips gently seaward to the drop-off of the continental slope, which becomes less steep on the continental rise.

Continental margin profiles in general are like deltas, except that the margins are basically continuous around all of the earth's continents. This likely evinces sheet deposition during the Recessive Stage of the Flood.[1–3]

According to plate tectonics, many passive margins formed on the edges of continents that rifted away from mid-oceanic ridges, thereby opening new oceans. Passive margins are found on both sides of the Atlantic Ocean and formed after spreading began. Coastal Great Escarpments, high cliffs or steep slopes close to the coast are found around many passive margins.[4]

Offshore areas subside, inland areas rise

The cause of passive margin uplift is unknown, since many mountain ranges in the plate tectonics paradigm are claimed to have uplifted by plate or continental convergence. Thus, many models have been suggested: "Even in the case of elevated continental margins such as in Scandinavia, Greenland, eastern Australia and southern Africa, various mechanisms are proposed."[5] Uniformitarian geologists propose the offshore area subsided due to thermal cooling after spreading and collected an enormous amount of sediment, while the onshore area rose, partly due to erosion and isostatic uplift. An escarpment formed on the continent and retreated inland. A planation surface formed early that is now above the escarpment, while another one formed below the scarp, supposedly over a long period of erosion.

The southern Africa passive margin

The story above is how uniformitarian geologists say the semi-continuous coastal Great Escarpment with its associated planation surfaces supposedly formed over 3,500 km around southern Africa (figure 1).[6] The escarpment has retreated inland about 100–200 km, assuming it started at or near the coast as many believe. Yet, some think the scarp retreated little from its current position and mainly eroded downward. The planation surface above the escarpment is up to 3,000 m above sea level at the Drakensberg of southeast Africa.[7] The coastal area is a dissected erosion surface.

The escarpment was formed on different rock types, with only local modification due to different rock types.[8] As such, the erosion seems to have paid little attention to the hardness of the rocks, which runs counter to the normal expectations of the uniformitarian paradigm. Ollier and Marker state: "The geological relationships thus show that the Great Escarpment is essentially erosional in origin while structure is of secondary importance."[9]

The escarpment crosses areas with a great variety of climates, ranging from warm humid to arid.[10] However, it remains similar regardless of the current climate; the climate seems to have had no impact on the origin or erosion of the escarpment. This also is unexpected within the uniformitarian paradigm.

While southern Africa was rising, the adjacent offshore areas were sinking and collecting the sediments that had eroded off the continent. South African geomorphologist, Lester King, commented on the dip of the seismically imaged sediments eroded from the continent to the offshore margin of southeast South Africa, indicating uplift during sedimentation:

> "We note that all the formations drilled dip offshore. The oldest and deepest formations dip at several degrees, the youngest and uppermost dip at less than one degree ... . As the monoclinal tilting is always seaward, *the land always moves up, the ocean floor always goes down* [emphasis added]."[11]

The latter statement is a clear statement of Psalm 104:8 by a uniformitarian geomorphologist! It confirms that the continents rose at the same time the ocean basins sank. The hinge line, which divides the rising land to the west in southeast Africa from the subsiding crust to the east, is close to the coast.

The Namibia passive margin

The escarpment along the passive margin of southern Africa ends just north of Namibia. Many believe this passive margin formed 130 million years ago with the breakup of the Pangean supercontinent.[12] The coastal Great Escarpment in Namibia is about 100 km inland and about 800 m high, which separates the coastal plain from the African plateau that covers 25% of Africa. The origin of the abnormal elevation of the plateau or planation surface is debated, with the time of its rise estimated anywhere from the Triassic to the late Cenozoic.[13] A coastal erosion surface is nearly flat with inselbergs, such as 600-m high Spitzkoppe. On the African plateau, several vast planation surfaces, separated by erosional scarps and dissected by rivers, are believed to exist. Apparently, the African plateau is not one continent-scale planation surface that was later faulted or folded to different elevations as some uniformitarian scientists believe.[14,15] Instead, it consists of several. Regardless, the origin of these planation surfaces is highly debated:

> "The inner parts of the continents are largely shaped by planation surfaces; the genesis of these surfaces have [sic] generated numerous debates between geomorphologists for more than a century."[16]

Several mechanisms for the Namibian passive margin uplift have been proposed, but some believe the deformation started only 10–20 Ma ago, 100 Ma after rifting. This conflicts with the assumption that the continental rifting caused the uplift. Another mechanism is 'dynamic uplift' caused by mantle flow. Picart *et al*. add their mechanism:

> "Therefore, we propose that the upper Cenozoic deformation of the Namibian plateau resulted from two successive processes. Variations in the spreading rate at the end of the Eocene generated the bulging of the coastal domain. The steepening of the slopes increased erosion and the retreat of the scarp. The mass loss was compensated by isostasy which maintained the upward motion and propagated it slightly inland"[17]

The escarpment is believed to have retreated inland at a rate of 5–7.5 km/Ma.[17] The mechanism for uplift and escarpment retreat seems unlikely. How can changes in spreading rates well out in the Atlantic affect the coastal uplift? Besides, steep slopes normally should become less steep with time due to mass wasting and rock fall.

Summary of uniformitarian difficulties

The above is evidence that uniformitarian scientists have a poor understanding of the cause of passive margin uplift, its erosion, the formation of planation surfaces, and origin of the Great Escarpment. There are four main difficulties. First, erosion should have been greater at higher elevations, and it is not.

Second, erosion should preferentially erode the softer rocks, but escarpment erosion affected similarly both soft and hard rocks.

Third, the escarpments still maintain steep slopes. If they were tens of millions of years old, they should have lost their steepness.[18]

Fourth, river valleys are generally perpendicular to the escarpments in the coastal sections. The river valleys have vertical walls and incomplete incision as though they have not yet adjusted to the uplift.[8] The vast erosion of the escarpment, therefore, is more likely to be rapid and recent.

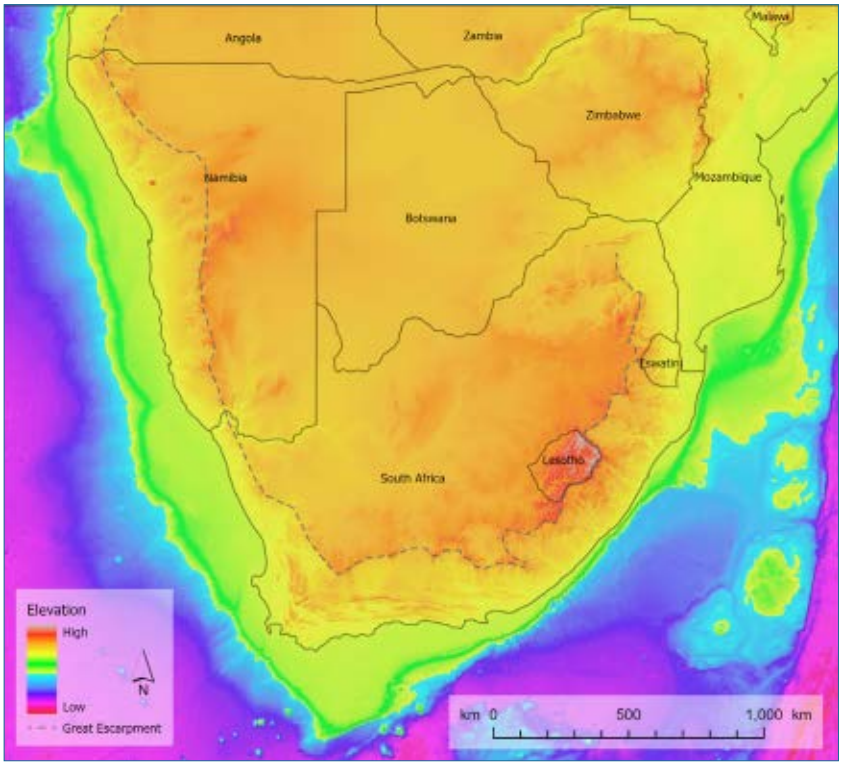

Figure 1. The Great Escarpment that parallels most of the coast of southern Africa (drawn by Melanie Richard)

Noah's Flood interpretation

The features of passive margins can better be explained by Noah's Flood. The coastal Great Escarpments first formed by continental uplift while the ocean basins sank during the draining of the floodwater. Whatever the geomechanical reasons for this uplift (it is currently unknown), the pattern fits well with enormous continental erosion that took place during the Recessive Stage of the Flood. It is the type of erosion one would predict during a retreating 'waterfall' as water flowed off of the rising land toward the sinking ocean. But this waterfall would be hundreds to possibly thousands of kilometres long, which would place it during the Sheet Flow Phase of Noah's Flood. Sheet erosion would have little concern for the hardness of the rocks or the present climate, and explains the large number of planation surfaces that take no notice of rock lithology or the present climate. Based on the volume of sediments offshore, the erosion over Namibia was immense. It appears that the average vertical erosion was about 2,400 m.[19]

Conclusion

Uniformitarian scientists have several difficulties explaining passive margin uplift. This is especially the case with the Great Escarpment that rims southern Africa. The erosional profile of the Great Escarpment does not fit

uniformitarian expectations. However, it fits very well the catastrophic erosion of the Sheet Flow phase of the Recessive stage of the Flood.

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Neanderthals could hear like modern man

Michael Oard

Secular scientists are finding more and more Neanderthal characteristics that are similar to, or the same as, modern man.[1] Neanderthals had a brain size a little larger than that of modern man. They buried their dead, likely built boats, talked like modern man, lived in cold climates, managed fire, painted on cave walls, made jewelry, probably made bone flutes for music, made string or cordage,[2] had diversified hunting strategies, ate diverse types of food, and dove for shellfish.[3] DNA studies reveal that Neanderthals were absorbed into modern people groups; every people group has a certain percentage of Neanderthal DNA.

Neanderthals can hear like modern people

To go along with Neanderthal's ability to speak, new research is showing that Neanderthals also could hear like modern people.[4] Conde-Valverde *et al.* recognize that bones cannot reveal whether Neanderthals could hear and speak, but they can study the particular bones that make speech and hearing possible. Although the issue of whether Neanderthals could speak is still debated, the evidence now indicates they could speak:

> "While this debate remains unresolved, recent anatomical and genetic data support the idea that Neanderthals could have produced a wide repertoire of acoustic signals, facilitating a complex form of vocal communication."[5]

So, the researchers reasoned that they likely had auditory capabilities similar to modern people. They then used sophisticated technology to detect this auditory capability:

> "Relying on computerized tomography scans and a comprehensive model from the field of auditory bioengineering, we have established sound power transmission through the outer and middle ear and calculated the occupied bandwidth in Neanderthals."[4]

They did their research on five Neanderthals. They determined the occupied bandwidth is related to oral communication. The results of their analysis indicate that Neanderthals were capable of hearing like modern man:

> "Our results show that the occupied bandwidth of Neanderthals was greater than the Sima de los Huesos hominins and similar to extant humans, implying that Neanderthals evolved the auditory capacities to support a vocal communication system as efficient as modern human speech."[4]

Some researchers refuse to accept that Neanderthals were just a people group of modern humans with some unique skull features. They declare that just because the 'hardware' for human hearing and speech existed, it does not mean that the mental 'software' was the same as *H. sapiens*. Because of their faith in evolution, they assume Neanderthal brains likely lacked some of the mental power of modern humans.

Neanderthal and the Sima de los Huesos hominin ears much different from apes

Conde-Valverde *et al*. did compare the ears of Neanderthals and Sima de los Huesos with apes and concluded:

> "Previous studies carried out on the European Middle Pleistocene fossils from the Sima de los Huesos (SH) and in early hominin taxa *Australopithicus africanus* and *Paranthropus robustus* from South Africa showed that the OBW [occupied bandwidth]

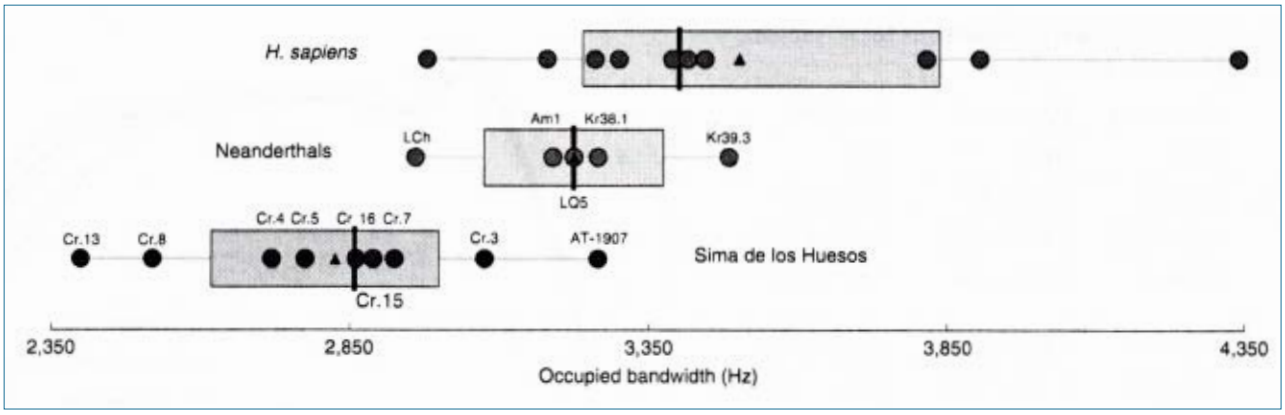

Figure 1. Occupied bandwidth for modern humans, Neanderthals, and Sima de los Heusos fossils[8]

in the early hominins was quite similar to *Pan troglodytes*, while the SH fossils had an OBW more similar to, although somewhat narrower than, *H. sapiens*."[6]

Pan troglodytes is the modern chimpanzee. This result is as expected by creation scientists, who have shown many of the so-called apeman fossils fall either within the variability of an ape or the variability of modern man. An in-depth analysis of these so-called fossil men has shown that the various *Australopithecus* fossils, *Ardipithecus*, *Orrorin tugenensis*, *Sahelanthropus tchadensis*, and many from the wastebasket taxon *Homo habilis*, are various types of apes.[7] Also, *Homo erectus*, Neanderthal Man, the Denisovans, *Homo heidelbergensis*, and *Homo floresiensis* are various people groups.

What about the Sima de los Huesos fossils?

The researchers claim an evolutionary progression from the 'older' Sima de los Huesos fossils found in northern Spain, to Neanderthal Man, then modern man (figure 1). The Sima de los Huesos fossils were once considered Neanderthals, but they have been subsumed into *Homo heidelbergensis*.[8]

The Sima de los Huesos fossil ear analysis results, shown in figure 1, reveal that the occupied bandwidth was lower than that of Neanderthals, although close to modern humans and far from the apes. This could simply be individual people group differences. Or it is possible that it could be due to the researcher's evolutionary bias. The researchers recognize that the Sima de los Huesos site provided evidence of "sophisticated stone tool manufacture (mode 2), evidence of communal hunting of large game species, incipient mortuary practices and con-specific care." However, this behaviour just reinforces their evolutionary opinions:

> "In our opinion, this is strong evidence in favour of the coevolution of increased behavioural complexity and increased efficiency in vocal communication throughout the course of human evolution."[9]

The lower value of the occupied bandwidth of Sima de los Huesos fossils in figure 1 was also due to the researchers adding three new individuals to a previous analysis, which had indicated the Sima de los Huesos fossils were closer to modern man. Could their evolutionary bias have produced this evolutionary progression in occupied bandwidth?

Regardless, the fact that Neanderthals had an occupied bandwidth within the range of modern people and the Sima de los Heusos fossils were close, and all were far from apes, indicates that the latter two groups were simply variants of modern man.

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What is the origin of clastic pipes?

Michael J. Oard

While examining sedimentary rocks in detail, uniformitarian scientists regularly discover perplexing features. True to form, they almost always apply present processes over long periods of time to explain their origin. Sometimes, the feature cannot be attributed to present processes, i.e. it does not comply with the uniformitarian principle. In these cases, a secondary hypothesis is applied, or many hypotheses are developed by different researchers. These may or may not be reasonable. One of these perplexing features is clastic pipes (figure 1).

Figure 1. Chimney Rock, a tall clastic pipe from Kodachrome Basin State Park, Utah, USA, left as a vertical column after erosion of the surrounding sediments

What are clastic pipes?

Clastic pipes are defined as "cylindrical columns of sandstone, which vertically crosscut original bedding with sharp contacts."[1] Some are 100 m in diameter and up to about 100 m tall.[2] Up to 100 or more pipes are sometimes found in a given area (figure 2). Occasionally, clastic pipes contain conglomerate or breccia, as those in Kodachrome Basin State Park, Utah, USA (figure 3). Clastic pipes are found within sediment or remain standing after the enclosing layers have eroded away. Clastic pipes can show much variability, such as flaring geometries at the top and bottom,[3] and concentric rings.[4] Others have unusual weathering pits up to 10 m deep at the top.[5] It is believed that the pipes formed at the same time as the sediment was laid down.[4]

Clastic pipes common in sedimentary rocks

Clastic pipes have been observed at many locations of the world:

> "Injectites, including clastic pipes and dikes, have been documented in ancient deposits worldwide, including studies in California (Sherry *et al*., 2012), Namibia (Moses and Cartwright, 2010), Patagonia (Hubbard *et al.,* 2007), the Mediterranean (Frey-Martinez *et al.*, 2007), and the North Sea (Duranti and Hurst 2004)."[1]

Clastic pipes are common throughout the Phanerozoic of the Colorado Plateau.[3] Over 100 clastic pipe locations are found in southeast Utah alone.[6]

Uniformitarian scientists not sure how the clastic pipes formed

Since sand dikes and boils are also observed after some earthquakes today, uniformitarian scientists think clastic dikes must be caused by liquefaction or fluidization related to earthquake shaking.[7] It is possible they are right, but the exact origin of clastic pipes still eludes them. So, many hypotheses have been developed:

> "Scientists have posed multiple hypotheses for the mechanism of pipe formation, including liquefaction from earthquakes (Obermeier, 1996) or meteorite impacts (Alvarez *et al*., 1998), coldwater springs (Hannum, 1980; Guhman and Pederson, 1992; Draganits *et al*., 2003), gypsum dissolution (Hunter *et al.*, 1992), groundwater movement (Dubiel *et al.*, 2014), and dewatering (Phoenix 1958)."[1]

Apparently, there are no modern analogues, which means that clastic dikes contradict the uniformitarian principle:

> "Although there are no known modern analogues to these huge masses of structureless sandstone, they may have a small-scale modern counterpart in earthquake-induced sandblows."[8]

Sand blows or boils are really not good analogs for clastic pipes since they are small scale and commonly not cylindrical in cross-section below the ground.

Creation science implications

Creation scientists can agree that clastic pipes likely were caused by liquefaction during earthquake shaking.[9] However, the quakes would have to be extraordinarily powerful, as would be expected during the global Flood: "The depth of liquefaction recorded by the pipes [in SE Utah] far exceeds depths usually considered in earthquake engineering."[10]

The sediments were apparently soft during the formation of the pipes, since there was no disturbance of the surrounding sediments and no indication

Figure 2. A group of clastic dikes in Kodachrome Basin State Park

of compressive strain.[9,11] From the uniformitarian perspective, the sediments would have had to remain soft for millions of years. Depending upon the precise uniformitarian date of the pipes, the sediments would have had to remain soft for a minimum of 13 Ma if the Carmel Formation averaged 179 Ma and the Entrada averaged 166 Ma.[11] But if Hornbacher is correct that the pipes are Plio-Pleistocene in age, then all the sediments in the region and the hundreds of metres eroded from the area had to remain soft for about 150 Ma.[9] Neither scenario is likely.

It is interesting that numerous pipes are found in what uniformitarian scientists consider lithified desert sands. For instance, they are common in the Navajo Sandstone, considered the largest lithified sand erg on Earth. The Navajo Sandstone is considered to have accumulated in a dry sand desert.[4] However, the Navajo Sandstone does have features that indicate it was not 'dry', such as widespread soft-sediment features indicative of dewatering,[12] 'stromatolites' that form in water,[13] carbonate layers with 'tufa' mounds,[14] crocodile fossils,[12] widespread petrified tree stumps and trees,[15] and numerous tracks of dinosaurs and other creatures.[16] Based on these observations, it is very likely that the Navajo Sandstone is not a desert sandstone, but was laid down in water, in the same way as what is now considered to be the origin of the classical 'desert' Coconino Sandstone.[17]

Figure 3. A close-up of conglomerate in the clastic pipe shown in figure 1

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The palmar grasp reflex is neither useless nor evidence of an ape past

Jerry Bergman

The palmar grasp reflex occurs when the infant's fingers reflexively flex around an object placed in its palm such as a caregiver's finger. The response is the result of a spinal reflex controlled by the higher brain centres.[1] This reflex, a universal trait of all healthy human infants, develops as early as in a 16-week-old fetus. As documented during routine ultrasound examination, the fetus begins to grasp the umbilical cord in the mother's womb as early as 25 weeks.[2] It persists until the development of rudimentary fine motor skills between age two to six months.

After the baby's fingers spontaneously curl around the object, they can hold on so tightly that the baby is able to support its body weight thereby. Stroking the back of the baby's hand usually will release its grip. When hanging by its hands from a horizontal rod, the baby's grasp reflex can hold its weight for about 10 seconds. In contrast, monkey infants are able to hang by one hand for more than half an hour. This reflex is essential for monkey infants to cling to the mother's body fur to nurse and travel from one location to another with the mother.

Vestigial claims

The palmar grasp reflex is listed as one of the seven leading examples of vestigial organs by the *Encyclopedia Britannica*.[3] Some evolutionists list it as a vestigial behaviour rather than an organ, but the ability is genetic and requires both the proper anatomy and physiology. The vestigial claim is even featured in several YouTube videos. In one example, the narrator calls the palmar grasp reflex "the most adorable vestigial behaviour".[4] The video shows a baby supporting its own weight, attributing its strong grip to its "inner monkey" (3:48).

Rogers, in an article about vestigial organs, admits: "Despite its diminished strength and loss in early infancy, some researchers think that the grasp reflex may retain important functions in humans."[3] Rogers has a point; even from an evolutionary perspective, if it had no important functions in humans, why would such a complex system have been maintained by selection?

The palmar reflex involves the premotor cortex, supplementary cortex, the brain cingulate motor cortex, and the spinal relay centre located in the cervical spinal cord. These systems are all involved in controlling the grasp reflex through the spinal interneurons. In addition, also involved are the afferent nerve fibres, including the ulnar and median sensory nerves that supply the palmar surface, and the motor nerves that supply the hand's flexors and adductors.[5] But there are more reasons than this complexity to support Rogers' statement.

The social bonding function

The mechanism of grasping, in other primates as well as in humans, appears to be significant in the social bonding needed for healthy emotional development. In the 1950s and 60s, psychological research was dominated by psychoanalysts and behaviourists, who espoused the view that babies became attached to their mothers largely because they provided food. Henry Harlow argued that this perspective overlooked the critical importance of contact comfort (touch/feel, including the infant clutching its mother), companionship, and love in promoting healthy development. Harlow took infant monkeys from their biological mothers and placed them with inanimate surrogate mothers. One surrogate 'mother' was constructed from wire and wood, and the second 'mother' was covered in foam rubber and soft terry cloth. The monkeys assigned to the foam rubber and soft terry cloth mother fared far better developmentally.[6]

Those with the wire and wood mother, though given a good diet, manifested very disturbed behaviour, sometimes staring blankly for hours, circling their cages, and engaging in self-mutilation. If these infants were re-introduced to their peer group, many stayed separate, some even refusing to eat.

Figure 1. Infant displaying palmar grasp reflex.

Modern researchers on human development stress the need for various forms of physical interaction for the healthy development of human infants as well. The palmar reflex is increasingly regarded as important in helping to develop the bond between mother, father (and others), and the baby.[7] A common behaviour of adult persons is to grab hold of an infant's hand to experience the grasping reflex. Other forms of contact are important, and the palmar reflex is only one means of contact, but a very important one in the infant's early socialization.[8]

Clinical implications of the grasp reflex

The numerous functions of the grasping reflex include its ability to stimulate the development of normal neurons and neural pathways that are foundational for later voluntary movements. Problems in this grasping reflex stage can cause developmental problems. Numerous studies document that for this reason, the reflex is a very important diagnostic tool.[9] In fact, the "plantar grasp reflex is of great clinical significance", especially in terms of the early detection of disease.[2]

Evolution claims

The palmar reflex is significantly more common in the infants of primates that carry their young by having them hang onto their mother's fur. This fact is used to support the theory that the grasping reflex evolved in species where the young can hold onto their mother's fur. This observation incorrectly indicates to evolutionists that the grasping reflex is vestigial in humans and other non-fur-carrying primates.[10]

This reflex is believed by evolutionists to have been essential in our distant monkey ancestors; enabling infants to cling onto their mother's fur while travelling and nursing.[11] One problem with this theory is that the young can be carried by different methods besides fur grasping, as is common in many primates. These other modes include oral holds, as is common in cats, or even riding on their mother's back.

Nonetheless, this reflex in humans is considered a major proof that humans evolved from monkey ancestors that lived an arboreal existence. When our ancestors lost their fur body-covering, according to Darwinists, the infants no longer required a powerful grasp but the genes and anatomy continued to display the grasp reflex. As it is not required in humans, infants typically begin to lose the reflex around the age of three months.[11] One of many problems with this fur-grabbing theory is that the grasping reflex is needed to properly develop higher levels of conscious hand and arm behaviour in many primate species. In a field study of this behaviour, Peckre observed that, of the 21 species of strepsirrhines studied, "fur-carrying species exhibited significantly *more* frequent manual grasping of food items".[10] This finding supports the fact that manual dexterity which exists for fur grasping also logically facilitates manual food-grasping development as well as grasping of other objects.

The prevalence of the Darwinist explanation for the human grasping reflex causes it to be commonly labelled as a 'primitive' trait. In a study of 47 premature infants, the grasping reflex, which the researchers labelled a 'primitive reflex', was present in all 47.[12] The title of the article used the term *evolution* when what was studied was normal *development*, not biological evolution. Although several theories of its evolution exist, as Peckre admits: "The origin and evolution of manual grasping remain poorly understood."[13]

Conclusion

The palmar grasp reflex is not vestigial, but has important functions including particularly as part of the developmental process leading up to the use of the hand for complex life in our human society. It is part of the design of the human body and involves many brain, nerve, muscle, tendon, and ligament systems. It also serves the important role of facilitating more effective bonding of the infant with its mother and other adults.

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Confirmations of highly inclined exoplanet orbits

Wayne Spencer

There has been increasing interest and new research into extrasolar planets that have highly inclined orbits compared to the orientation of their stars. This was first referred to by Spencer in 2010[1] for the case of an exoplanet known as WASP-17b (The acronym 'WASP' represents a British project called the 'Wide Area Search for Planets'). In theories of the formation of planets, the star first forms in a flattened disk of gas and dust. The planets then form from the gas and dust in the spinning disk. Since the newly formed planets in this scenario would get their motion from the spinning disk, the planet orbits would normally be expected to be lined up close to the equator of the star. But in some cases exoplanets have been discovered in which the orbit inclinations are very different from the plane of the equator of the star. This raises questions about how these exoplanetary systems came into this configuration. These cases have been challenging for planetary scientists to explain. In our own solar system, this angle between the solar equator and the ecliptic plane of the planets is approximately 7°.

In mid-April of 2010, a conference was held at the University of Glasgow for astronomers. This event was the National Astronomy Meeting of the Royal Astronomical Society (RAS). At this meeting it was announced that scientists had discovered that in a group of 27 exoplanet cases studied, six of these planets seemed to be moving retrograde in comparison to the spin axis of their star. This was quite a surprise.[2] At the conference, the report on the six retrograde exoplanets was presented by Andrew Cameron. He made the statement: "The new results really challenge the conventional wisdom that planets should always orbit in the same direction as their stars spin."[2]

Measuring misalignments

Since 2010 there has been more research on similar cases, and scientists are attempting to refine their methods for investigating these stars and their exoplanet orbits. Today these exoplanets are referred to by scientists as 'misaligned' when the plane of the exoplanet's orbit is significantly different from the equator of the star. There are many factors that complicate observations of the inclined exoplanets. Multiple types of data have to be combined in order to properly determine the properties of the star. Once the star's spin axis can be determined with some confidence, then it may be possible to determine the angle between the stellar spin axis and the exoplanet orbit. Some key techniques involved in these determinations are asteroseismology, spectroscopy measurements of the transit light curve, and what is known as the Rossiter-McLaughlin effect (figure 1).

The first requirement in determining the inclination of the exoplanet orbit is that the planet must transit the star along our observational line of sight. (In a transit, the exoplanet passes in front of the star.) The transiting planet causes a dip in the light curve from the star. Asteroseismology is then used to analyze oscillatory modes of the star to determine a number of stellar properties, including its spin axis.[3]

The Rossiter-McLaughlin effect affects Doppler measurements of redshift during a transit. Due to the star's rotation, one side of the stellar disk moves toward the observer (and is blueshifted) while the other side of the star moves away from the observer (redshifted). As the planet passes in

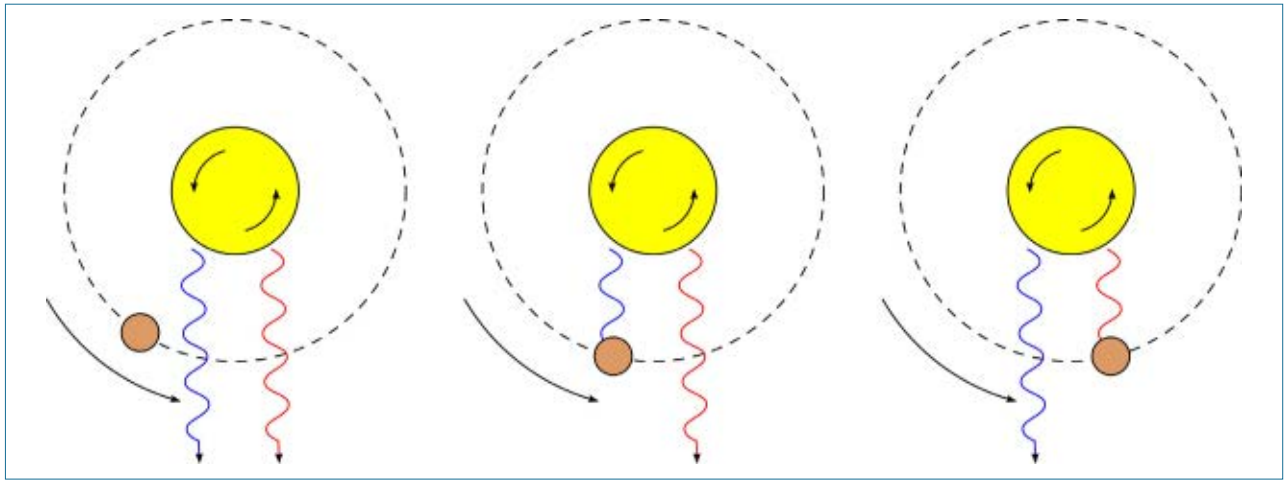

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Figure 1. In the graphic an Earth observer looks at the rotating star from the bottom. The star will have blueshifted light on the side of the yellow disk that moves toward the observer and redshifted light on the opposite side. When an exoplanet passes in front of the star it will first block the blueshifted light (middle picture) and then block the redshifted light (right picture). The change this causes in the redshift is known as the Rossiter-McLaughlin effect.

front of the stellar disk, it blocks part of the blueshifted light and then blocks part of the redshifted light (figure 1). This produces a measurable effect in the redshift at the edges of the star.[4,5] This causes the redshift to be skewed in a manner that depends on the angle between the orbit of the planet and the spin axis of the star. The actual geometry is complicated because in doing an observation, the observer is seeing a projection of the stellar spin axis and a projection of the exoplanet's orbital plane. Thus, the variations in the star and the Doppler transit data are examined over a period of time and a model of the motion of the star and the planet is constructed to explain the variations in the light curve.

There are two angles used in reference to these cases, one is denoted by the Greek letter λ (lambda), which is the projection of the spin-orbit angle on the plane of the sky. This angle is what is observed but the actual angle desired is in a different plane. So, the goal is to determine in three dimensions the angle between the stellar spin axis and the planet's orbital axis, denoted by ψ (psi).[3] The angle ψ is known as the stellar obliquity. Only some transiting exoplanets have been sufficiently studied to determine both of these angles. The results can vary from different research teams measuring the two angles. In 2017 Spencer listed 20 cases of inclined exoplanet orbits for 16 stars.[6] In those cases, the ψ angle ranged from 0 to 145°. (Note that an angle ψ greater than 90° is considered retrograde, although exoplanet cases close to 90° are often described as being in 'polar orbits'.)

It is instructive to consider how much variation in the λ and ψ angles there can be from different observations and different analyses. A concern might be raised over whether the conclusions correctly follow from the observations. Can the high angles for λ and ψ be reproduced? To show an example we can consider exoplanet HAT-P-7b. Exoplanet HAT-P-7b may be one of the most studied cases of exoplanets and thus multiple teams have done observations and analyses. Table 1 shows four sets of values for the λ and ψ angles, along with the amount of possible error or uncertainty estimated by the various researchers. In table 1, each name under the 'Source' column represents a team of researchers with a published source. The Winn[7] and Narita[8] sources, as well as Albrecht[5] all did their own original observations of the HAT-P-7 star. Later, the Lund[3], Benomar,[9] and Campante[10] teams re-analyzed the data. Note that the uncertainties in both angles is significant and is estimated very differently by different researchers. Yet, in spite of this, the final results for angle psi are similar, with the angle estimated to be from 94.6° to 116.4°. Thus, this planet is in a roughly polar orbit around its star. This conclusion is certainly borne out by multiple researchers.

Origins of inclined exoplanet orbits

In the accepted origins scenarios for the formation of stars, disks, and planetary systems, this raises interesting questions. From a creation perspective, a Creator could create an exoplanet with any orbit inclination about its star. But from a naturalistic or evolutionary perspective, it requires scientists to put forward creative scenarios. One common approach is to propose that a planet near the star, as it migrated in, would have its orbit altered over long periods of time by another planet (or possibly a second star) in a more distant but inclined orbit. This is sometimes referred to as the Kozai effect.[11,12] The Kozai mechanism relies on there being a few planets or objects in orbits that are in differing planes that can perturb each other over time. A planet migrating inward can be influenced by tidal effects from the star as well. Near passes between planets can also cause an orbit inclination to change. Planet–planet scattering scenarios like this tend to require billions of years of time. Planet–planet scattering scenarios also require that there be a third object (a planet or star) in certain types of inclined elliptical orbits. In many systems there is no observational evidence of such a third object.

Other scenarios have been put forward that try to provide a mechanism for the star and the disk around it to be

Table 1. Results from RM measurements for the HAT-P-7b transit. Bracketed references are for earlier teams who did original observations which were subsequently reanalyzed by others. Psi is the estimated actual angle between the angular momentum vectors of the stellar spin axis and the planet orbit.

Star Name	Source	Lambda (λ) in°	Lambda Uncertainty	Psi (ψ) in°	Psi Uncertainty
HAT-P-7	Winn, 2009[7]	182.5	±9.4	94.6	+5.5, -3
HAT-P-7	Lund, 2014[3] [Albrecht, 2012[5]]	155	±16.3	97	±14
HAT-P-7	Benomar, 2014[9] [Narita, 2009[8]]	220.3	+8.2, -9.3	115	+19, -16
HAT-P-7	Campante, 2016[10] [Albrecht, 2012[5]]	155	±37	116.4	+30.2, -14.7

misaligned early during the formation of the star. One approach to this suggests the magnetic field of the star can tilt the star relative to the disk.[13] Another proposal is that in some systems if gas and dust falling onto a forming star falls inward with a nonsymmetrical configuration it can cause the resulting star to have a different orientation than the resulting disk.[13] Another view suggests that the star formed in a cluster of multiple newly forming stars and the interaction of the stars near each other distorts, truncates, and tilts the disk before the planets form.[14] Then the planet (or planets) form from what remains of the disk. These types of scenarios might be described as 'early tilt' mechanisms. In these 'early tilt' scenarios there is less reliance on exoplanet orbit migration. Instead, the orientation of the star compared to the disk is determined early while the star is young and then the planets form later. A potential problem with these scenarios is that the disks tend to be disrupted by the processes and so there may not be enough material left to form planets. Also, all of these early-tilt scenarios depend on complex theories of star formation which are totally theoretical and not verifiable by observations.

A number of researchers have noticed another curious correlation between the effective temperature of the star and its obliquity angle ψ. It seems that hotter stars tend to have more highly tilted orbits for their exoplanets. More research is needed on potential causes of this correlation. Some researchers argue it relates to the 'early tilt' star formation scenarios above.[15] However, Winn[16] and Albrecht[5] have suggested it could be a tidal dissipation effect relating to the interaction of the star and the planet. As the planet migrates inward toward the star tidal forces become stronger. It is thought that a hot star is more likely to change the tilt of a planet orbit but a cooler star may come into alignment with the planet orbit.

Conclusions

The exoplanets with misaligned orbits will continue to motivate much research by planetary scientists. The critical examination of theories it motivates is a healthy exercise in science. How many exoplanets have these 'misaligned' orbits? There are various estimates, but it may be that approximately 40% of transiting exoplanets which have been studied using the RM measurements could be considered misaligned. Out of this 40%, only a few are likely to be actual retrograde cases. Benomar *et al.*[9] summarize the problem:

> "Among the 70 transiting planetary systems observed with the RM effect, more than 30 systems exhibit significant misalignment with $|\lambda| > 22.5°$ ... . This unexpected diversity of the spin–orbit angle is not yet properly understood by the existing theories, and remains an interesting challenge."

That there are highly inclined exoplanet orbits (relative to their stellar equators) is not disputed today among planetary scientists. This finding has challenged exoplanet formation theories and has led to new theories to attempt to explain these cases. The diversity of exoplanets points to God's creativity and power. Though Scripture does not mention planets in Genesis Chapter 1, it seems logical to put the supernatural creation of planets along with the creation of stars on the fourth day of the Creation Week. Without acknowledging supernatural creation, scientists are forced to propose very complex scenarios to explain exoplanet diversity. The variety of planetary systems God created continues to surprise and challenge scientists. Supernatural creation as outlined in Genesis is still a viable explanation.

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Rising waters separated Britain from Europe?

Philip Robinson

Researchers suggest that Britain was separated from Europe in two distinct stages.[1] Both stages occurred during the Quaternary Ice Age (2.58 Ma – 10 ka), the last of the five major ice ages proposed in the evolutionary timeline. The first stage, which has previously been documented, involved a huge land bridge made of chalk running between Dover, England, and northern France. The exposed land bridge was just one of a number of sedimentary rock layers that ran continuously between these two geographical locations at that time.

Rapid erosion

Known as the Weald-Artois Anticline (land bridge), it allowed a wide range of animals, including hippopotamuses, to migrate from mainland Europe into Britain. This land bridge was washed away around 450 ka ago (in the evolutionary timeline) due to a huge Ice Age lake bursting just to the north of it in the southern North Sea.[2,3] The resulting deposition and extensive erosional scars in the seabed are found in (and formed) the English Channel just to the south of where the land bridge was situated. This is a very clear example of the power of water acting quickly to remove a huge geological structure.

Doggerland exposed

In the evolutionary timeline there are numerous glacial and interglacial periods during the five ice ages. It was during the last period of glaciation, around 20 ka ago, that Britain was once again connected to North West Europe. This was an exposed area of low-lying land called Doggerland, which at its maximum ran between England, France, Germany, Holland, and Denmark. The existence and habitation of Doggerland is well attested to, with remains of mammoths, lions, and flint tools being regularly dredged up by fishing trawlers in the North Sea.[4,5]

Doggerland consumed

As the last period of glaciation began to subside, with the ice melting water levels rose and Doggerland began to disappear, once again separating Britain from mainland Europe, leaving only a collection of islands. A proposed submarine landslide that occurred 8 ka ago, the Storegga Slide, triggered by an earthquake just off the

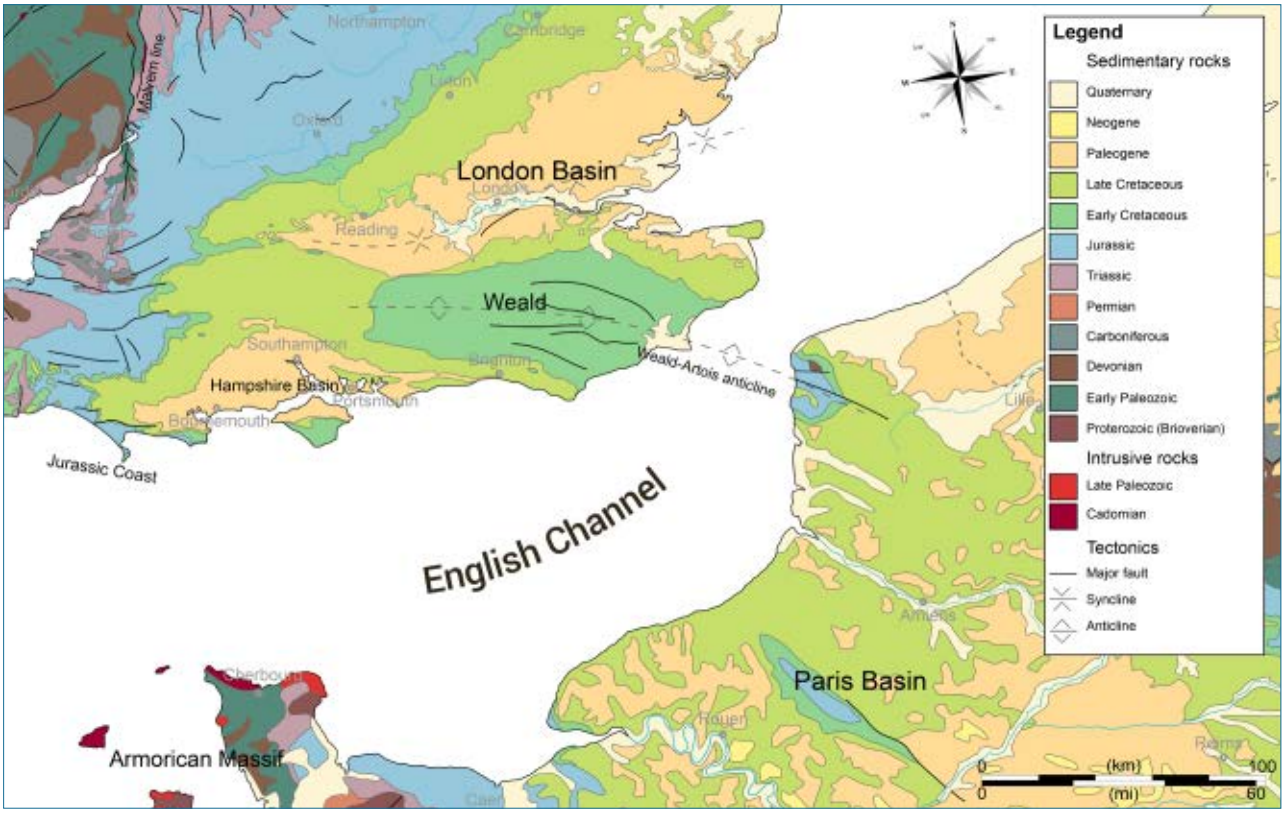

Image: Woudloper/CC BY-SA 3.0 (modified)

Figure 1. The Weald-Artois Anticline linking England and France

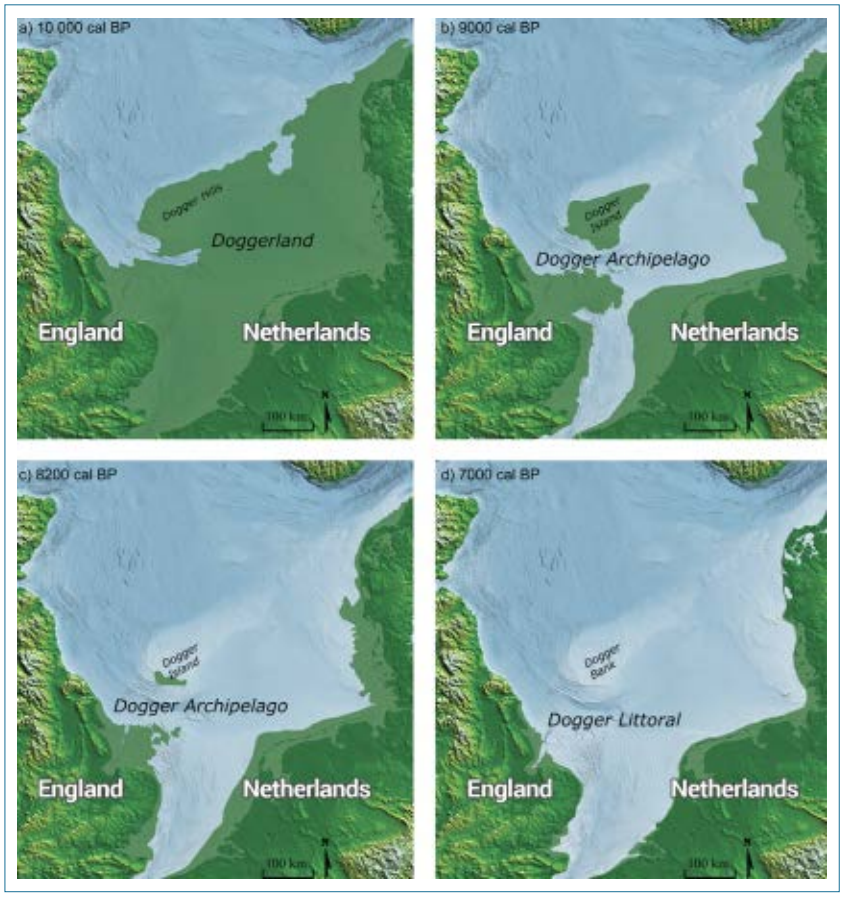

Figure 2. North Sea coastline reconstructions using evolutionary timeline for: a) Doggerland at its maximum *c.* 10000 cal BP; b) Dogger Archipelago *c.* 9000 cal BP; c) Dogger Archipelago *c.* 8200 cal BP; d) Dogger Littoral *c.* 7000 cal BP.

coast of Norway, then caused a tsunami in the North Sea. It was assumed that this wiped the islands away. However, the researchers, based on new sediment samples from the east coast of England, say this may not have been the case. They suggested that floodwaters from the tsunami withdrew, didn't cause the islands final demise, and the landscape recovered temporarily.[6] Instead, "the eventual inundation of the remaining parts of Doggerland resulted from the inexorable sea-level rise, rather than a lasting inundation from the Storegga tsunami".[7]

A biblical timeline

Biblical creationists have long explained that there was only one Ice Age (lasting between 500–700 years), which occurred directly after the Noahic Flood, around 4.5 ka ago. During this time, the landscape around coastal areas changed rapidly, with water from the sea being stored on land as an ice sheet 1–2 km high, which later melted and returned to the sea. The chalk land bridge connecting modern-day England and France would indeed have allowed animals and humans to cross until it was washed away.

The area directly behind the land bridge where the huge Ice Age lake burst, up to the edge of the ice sheet, would have been briefly exposed an area of low laying land, now called Doggerland. From the material dredged up, it appears to have been temporarily inhabited before the water level rose to its current height, once again covering it. Of course, for people, animals, and plant life to move into, inhabit and grow e.g., this area would be able to take place quickly as they would have been living in the surrounding higher areas already.

Dogger Bank, an underwater area of 17,600 km^2 (6,800 sq. mi.) with water depth ranging only between 15–36 m (50–120 ft) still remains in the southern North Sea. It is the eighth largest sea-based sandbank in the world, and due to its relatively shallow depth and nutrient-rich currents is an important fishing area. As fishermen continue to dredge up material belonging to Noah's descendants and the remnants of this early post-Flood civilization[8] on the vast plain now called Doggerland, it may provide us with further information as to their lifestyle and movement into Northern Europe.

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Geochemical and related evidence for early Noah's Flood year

I found the recent article by Harry Dickens and Aaron Hutchinson entitled "Geochemical and related evidence for early Noah's Flood year" fascinating.[1] I agreed with the bulk of their conclusions for the Mackenzie Mountains, especially the location of the pre-Flood/Flood boundary. However, I was a bit disappointed with a couple of their conclusions, in particular their interpretation of the $^{87}Sr/^{86}Sr$ values found in carbonate rocks globally.

In his classic textbook on isotope geology, Gunter Faure (p. 187) explained that the $^{87}Sr/^{86}Sr$ value found in rocks is controlled by the interaction of three sources: (1) young volcanic rocks or newly created seafloor; (2) weathering of old continental crust; and (3) Phanerozoic marine carbonate rocks.[2] Furthermore, Veizer and Mackenzie argue that the $^{87}Sr/^{86}Sr$ is primarily controlled by the formation of new oceanic crust and by river influx due to the erosion of the continents.[3] In their article, Dickens and Hutchinson correctly pointed out that higher $^{87}Sr/^{86}Sr$ values are primarily caused by increased weathering of the continental crust, and its associated river influx to the oceans. And that lower $^{87}Sr/^{86}Sr$ values are likely from oceanic sources and possibly hydrothermal activity. However, throughout most of their paper they place primary emphasis on just two factors to explain the changes in the $^{87}Sr/^{86}Sr$ values, namely, erosion of continental crust and hydrothermal activity (p. 82). They seem to dismiss the contribution of newly created seafloor as a major controlling factor, especially in the Sauk sequence and thereafter in the Phanerozoic as a whole. Faure (p. 191) attributed the lower $^{87}Sr/^{86}Sr$ values in the Mesozoic to increased rates of seafloor spreading and the opening of the Atlantic Ocean.[2] And my own research has strongly suggested that the $^{87}Sr/^{86}Sr$ values found in the rocks of the Phanerozoic are intimately connected to the production of new seafloor.[4] There will be more on this below.

Secondly, they interpreted the drop in Late Cambrian and post-Cambrian $^{87}Sr/^{86}Sr$ values to be caused from the complete inundation of all land surfaces. This process, they argue, cut off the contribution from the continents and lowered the Sr ratio (their figure 3, p. 83). However, this seems too simplistic of an explanation and does not match the rock record which shows only minimal flooding of the continents at that point in the Flood

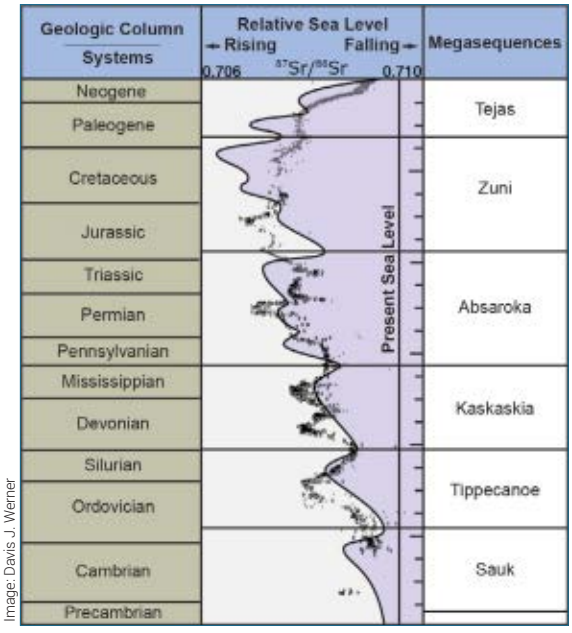

Image: Davis J. Werner

Figure 1. The $^{87}Sr/^{86}Sr$ values superimposed on a nominal geological column representing the earth's relative sea level during deposition of the six megasequences and associated geologic systems.[4] Note the $^{87}Sr/^{86}Sr$ values decrease to the left and the sea level curve decreases to the right. The sea level curve is a diagrammatic rendition based on the extent and volume of megasequences mapped across four continents (North and South America, Africa and Europe).

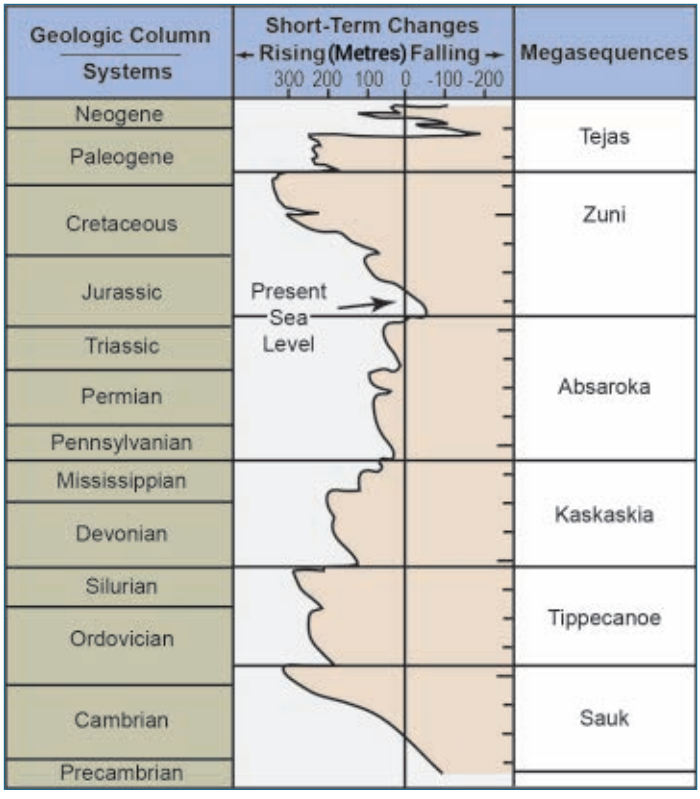

Image: Andrew Snelling

Figure 2. Secular global sea level curve with geologic time as constructed by Vail and Mitchum

year (Sauk and Tippecanoe megasequences). The stratigraphic data indicate a progressive Flood that peaked later (Day 150).[5–8] Furthermore, their argument is countered by examination of the Sr ratio in the rocks above the Sauk megasequence. I will admit the $^{87}Sr/^{86}Sr$ values do reach a peak in the Cambrian strata, as they pointed out on page 85, and is possibly due to early Flood erosion, but the $^{87}Sr/^{86}Sr$ values also return to that same peak ratio (nearly 0.710) in the present (figure 1). What is their mechanism to accomplish this return to the same ratio today as in the Cambrian? I suggest it is the near stoppage of seafloor spreading. Again, more on this below.

Finally, I feel they too readily accept the secular sea level curve as valid (figure 2), using it along with the post-Cambrian drop in $^{87}Sr/^{86}Sr$ values to claim that the Flood covered the entire earth during the Sauk sequence. Again, I would have liked them to have included an explanation of their mechanism to accomplish this complete flooding of the earth so early in the Flood, both scientifically and biblically. We are told in the Bible that the Ark started to float only after or on Day 40 of the Flood (Genesis 7:17). And unfortunately, the arguments they used for accepting a high sea level and complete flooding of the earth in the Cambrian (Sauk) are based on decades-old work by Exxon and other oil companies. I used these curves while looking for oil with Chevron. Remember, they had a much smaller data set to work with at that time, with very little deep-water control. In addition, Vail and Mitchum have openly admitted that the Paleozoic part of the global sea level curve is the least constrained, and therefore most subjective.[9] Haq *et al*. have concentrated more recently on Mesozoic and Cenozoic sea level changes and have added very little to the Early Paleozoic cycles.[10]

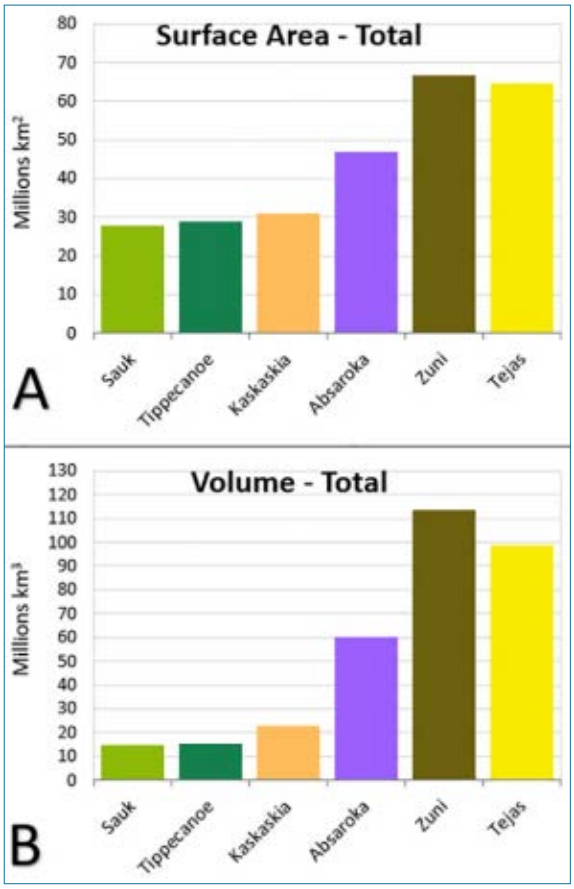

Image: Davis J. Werner

Figure 3. Histograms of (A) total surface extent by megasequences and (B) total volume by megasequence. Both show minimal extent and volume in the Sauk and a simultaneous peak in the Zuni megasequence. Both histograms total stratigraphic data from four continents (North and South America, Africa and Europe).

Indeed, stratigraphic columns across multiple continents have demonstrated that the extent of the Sauk and Tippecanoe megasequences are consistently the least in volume and areal extent compared to all later megasequences (figure 3).[5–8] Figure 3 shows that the extent and volume of sedimentary rock continued to rise, after the Sauk, and eventually peaked in the Mesozoic Zuni megasequence.

Figure 1 shows that the $^{87}Sr/^{86}Sr$ ratio progressively dropped throughout the Phanerozoic until reaching its lowest values in the Zuni megasequence (about the Jurassic level). This Sr ratio curve does, in fact, match the rock data mapped globally as both peak simultaneously in the Zuni megasequence, one low and one high (an inverse relationship). What would cause the rock data and the Sr ratios to track each other so closely?

I suggest the changes in $^{87}Sr/^{86}Sr$ values are primarily driven by the production of new seafloor. This best explains the lowering of the $^{87}Sr/^{86}Sr$ values that started in the late Cambrian and continued through the Paleozoic and Mesozoic, and even through the Cenozoic, and its return to near 0.710 today (figure 1). Hot, new seafloor is more buoyant and thicker and pushes up the ocean water from below. So, the more that new seafloor is created, the more the ocean level rises. The observed gradual lowering of the $^{87}Sr/^{86}Sr$ values can be directly correlated with the rapid production of new ocean lithosphere during the Flood year. During deposition of the earliest megasequences, it's likely only small amounts of new seafloor were added. This pushed the sea level up slightly at the beginning of the Flood (and began to lower the Sr ratio) while only affecting limited parts of the continents (Sauk and Tippecanoe sequences), matching what the rocks show.[5-8] As more seafloor was created in the Late Paleozoic and into the Mesozoic on a massive scale, it pushed the Flood water higher and higher until it reached its highest level (and lowest $^{87}Sr/^{86}Sr$ values) during the Zuni megasequence (figure 1). This can be confirmed by examining figure 3. If they turn the histograms in figure 3 on end, they closely track the $^{87}Sr/^{86}Sr$ curve shown in figure 1.

I commend them on a nice paper, and they made some great interpretations on the location of the pre-Flood boundary, but the discussion toward

the end of their article was too heavily biased on geochemical signals and not enough on the rocks themselves. I don't think they should so easily dismiss what the stratigraphy indicates, nor the Sr ratio curve throughout the entire stratigraphic record. In contrast, progressive production of seafloor during the Flood year does explain the post-Cambrian, systematic decrease in $^{87}Sr/^{86}Sr$ values and their close, although inverse, match to the global stratigraphic patterns. But we can agree to disagree on this.

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» Harry Dickens and Aaron Hutchison reply:

We commend Tim Clarey and coworkers for their great work in mapping megasequences. We thank them for their comments. Significant issues have been raised, which we attempt to

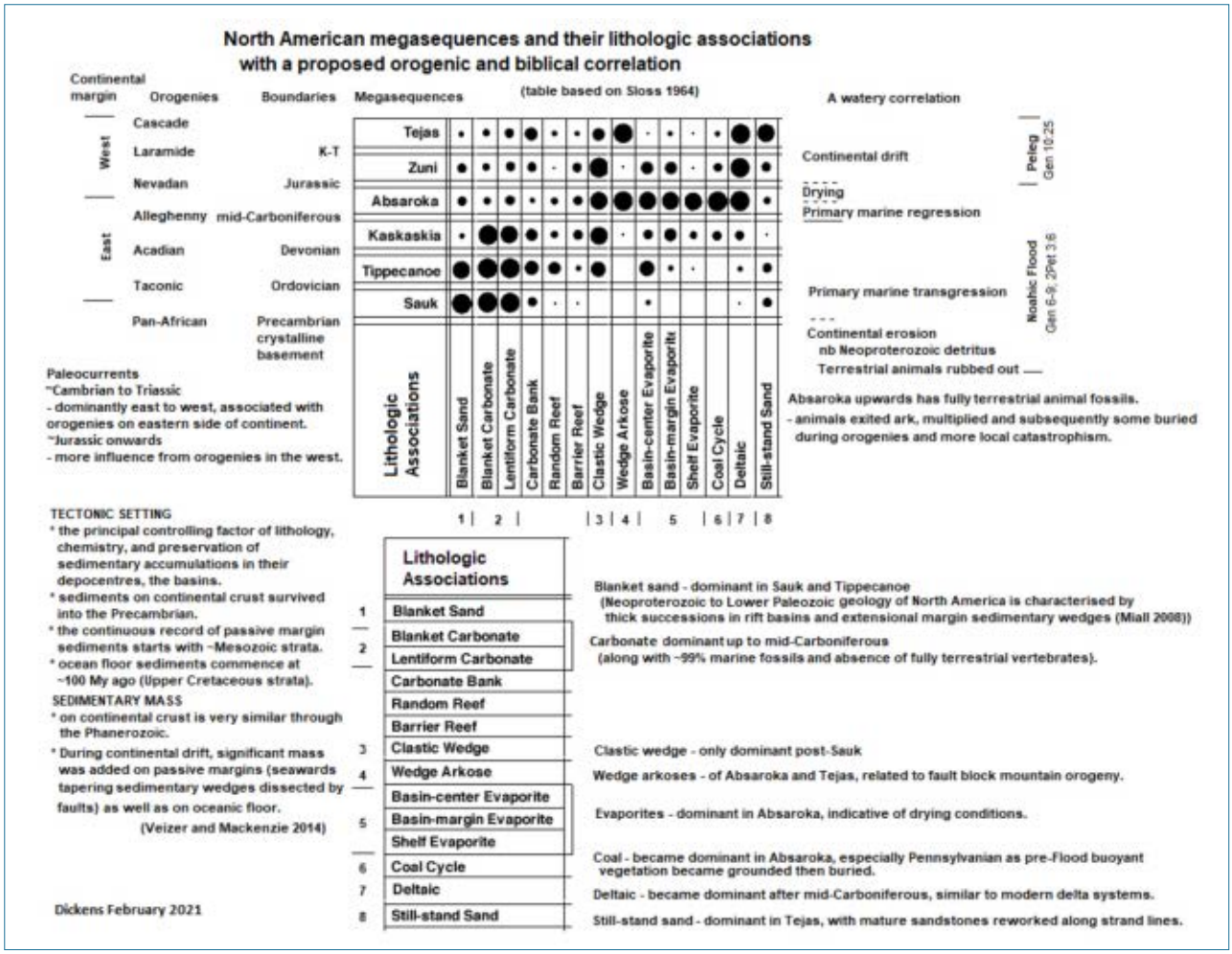

Figure 1. Megasequences on the North American craton with lithologic associations,[13] with a proposed orogenic and biblical correlation. The role of tectonism in the formation of megasequences is evident from the timing of orogenies[14] and of significant paleocurrent directions.[15]

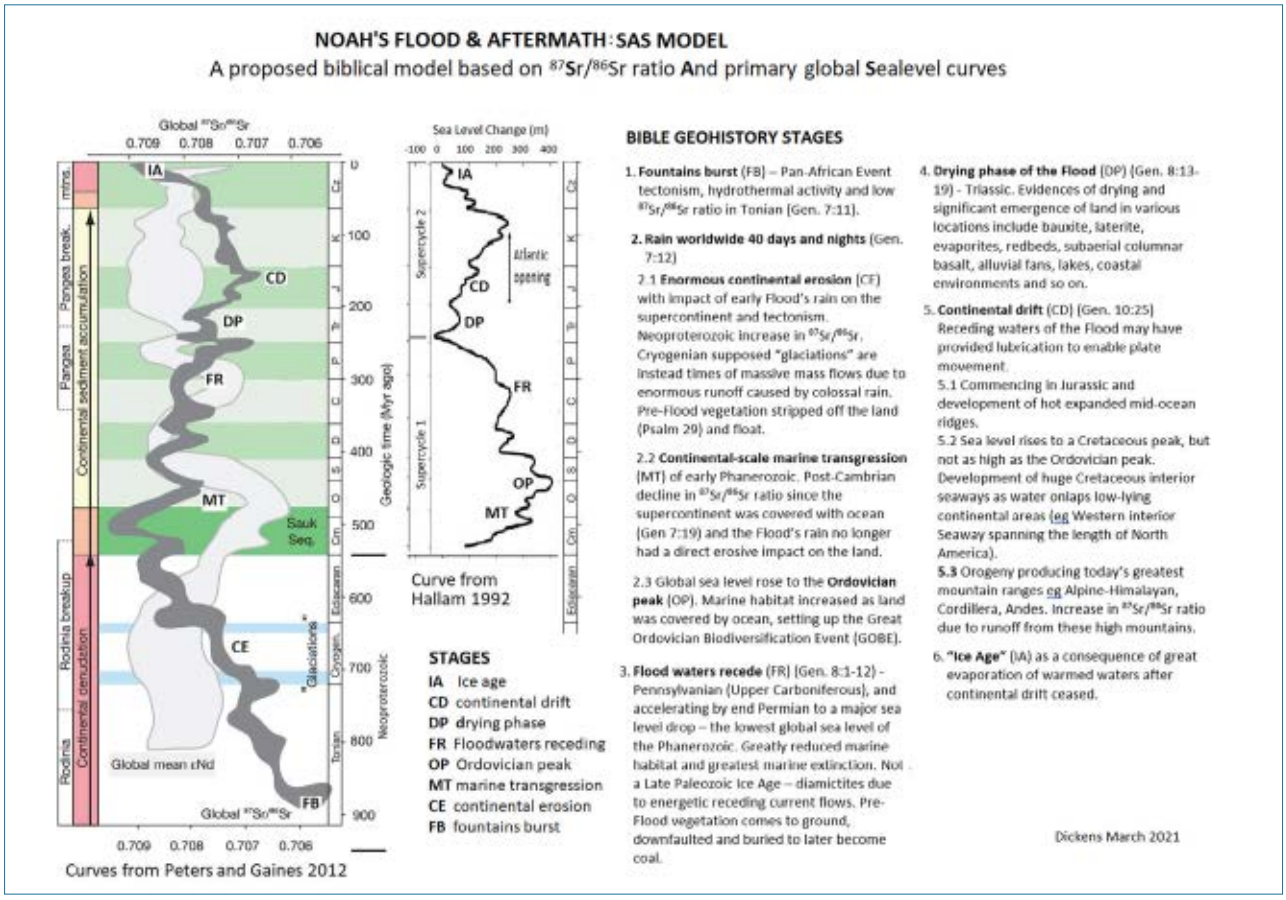

Figure 2. A proposed biblical model using curves of strontium isotope ratio $^{87}Sr/^{86}Sr$[22] and of global sea level[16] as reference for stages in Noah's Flood and its aftermath.

address in the following, as we all seek to refine our models of Earth history.

Rock data in addition to physical dimensions

- Rock characteristics in addition to areal extent and volume include minerals, chemistry, sorting, grain size, bedding, unconformities, colour, and fossil content.
- A facies is a body of rock in a geographic area with specific characteristics including its chemical, physical, and biological features that distinguish it from adjacent rock. Sedimentary facies reflect their depositional environment, each facies being a distinct kind of sediment for that area or environment.[1] Figure 1 shows such lithologic associations for North American megasequences.

Sediment area and volume

Factors influencing the dimensions of sedimentary sequences include:

- With greater rain and also higher topographic relief, there is increased continental erosion and runoff, then deposited as sediment. Great thickness of Neoproterozoic strata (some 10 km in our paper) was essentially due to the early Flood Year's powerful continental erosion caused by 40 days and nights of stupendous rain, and is not related to sea level height.
- In contrast, marine transgression is accompanied by a *reduced* sediment influx to the basin.[2] Sediment thickness in today's oceans averages less than 1 km and water depth has no obvious correlation with sediment thickness.[3]
- North American Cambrian to Mississippian cratonic sedimentary successions (Sauk, Tippecanoe, and Kaskaskia megasequences) are dominated by marine carbonates.[4] These have smaller volumes and areas, consistent with their dominantly marine lithologies.
- In contrast, North American post-Paleozoic cratonic successions (Upper Absaroka, Zuni and Tejas megasequences) are dominated by terrigenous clastics.[4] This is consistent with runoff associated with great mountain building, especially on the Cordilleran continental margin.

Stratigraphy and sea level

We referred to Hallam's Phanerozoic sea level curve (figure 2) which

took into account not only seismic stratigraphy (developed by oil companies), but also techniques such as paleogeographic mapping, depth-related invertebrate and algal groups, glauconite concentration, and facies correlation.

Hallam's curve shows sea level rose in the Cambrian to the highest sea level in the Ordovician. This coincides with a peak in biodiversity (figure 3) known as the Great Ordovician Biodiversification Event.[5] This can be related to increased area of marine habitat.[6] The second-highest sea level peak is in the Cretaceous. This is consistent with less than a globe-covering ocean, but with interior seaways (figure 4).

Earth's complete flooding began early in the Flood year

40 days and nights of rain is recorded at the very beginning of the Flood account. This was the source of the bulk of the water that eroded the pre-Flood land and flooded the earth. The Hebrew word *mabbul*, translated as Flood, has been referred to as the 40-day marine transgression at the Flood onset.[7] We consider that Cryogenian through Cambrian strata were formed then. Marine carbonate dominance peaked during the Great American Carbonate Bank in the Late Cambrian and Early Ordovician and is unrivalled in North America's Phanerozoic.[4]

A classic fining upward succession indicating marine transgression occurs in Grand Canyon strata (Cambrian Tapeats Sandstone then Bright Angel Shale, followed by a sequence dominated by marine carbonates up to the end Mississippian). Water covering the earth up to day 150 is consistent with the dominance of marine carbonates up to end Mississippian. Around the world there is a prominent mid-Carboniferous unconformity,[8] some of which is karstic such as in the Grand Canyon. Karst is associated with subaerial exposure to rainwater. Sea level

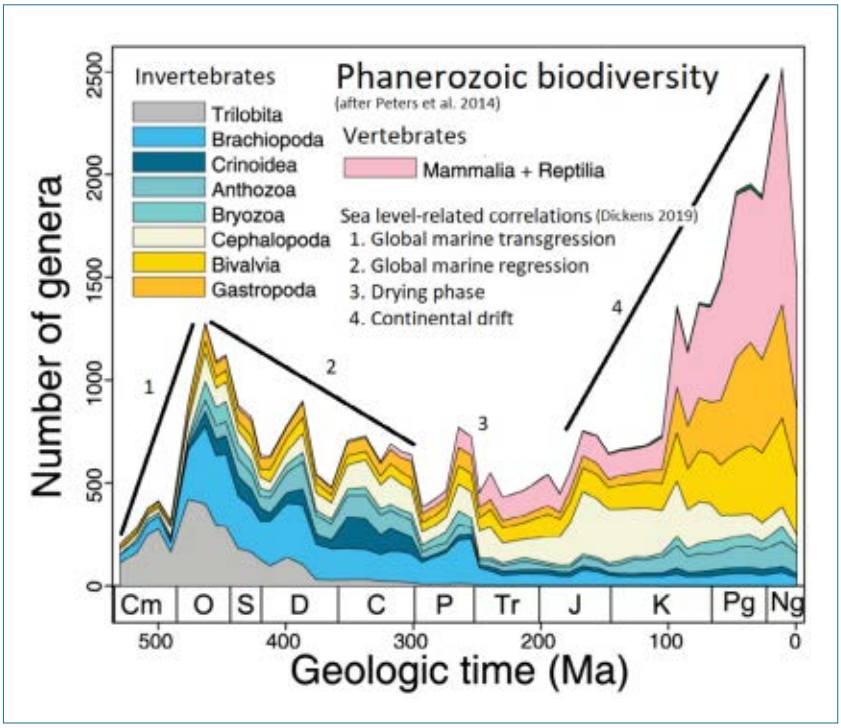

Figure 3. Phanerozoic biodiversity curves by number of genera.[17] The Paleozoic trend, of increase in marine invertebrate genera to an Ordovician maximum (the Great Ordovician Biodiversification Event) and then decline, corresponds well with Hallam's sea level curve (of marine transgression then regression) seen in figure 2. The post-Paleozoic great increase in genera corresponds well with the opening of today's great oceans in the time of continental drift.

drop accelerated from the end Mississippian to the lowest point in the end Permian (figure 2), the time of the greatest mass extinction.

Sr ratio curve—both continental and oceanic influences

Our paper emphasized continental erosion and hydrothermal activity, since we were considering the early Flood Year's rain and fountain activity. The opening up of today's oceans is believed to have occurred later—evident from Mesozoic and Cenozoic stratigraphy. It is important not to conflate the two episodes.

Powerful continental erosion with the early rain was sufficient to peneplane crystalline basement rocks seen in the Grand Canyon and this is consistent with the increasing Neoproterozoic $^{87}Sr/^{86}Sr$ ratio. Post-Cambrian decline in $^{87}Sr/^{86}Sr$ represents marine transgression followed by marine regression on the craton. The Triassic has numerous indicators of drying such as the widening of arid and semiarid belts[9] and dominance of evaporites in North America's Absaroka megasequence (figure 1).

Today's oceans began opening up significantly in the Jurassic,[10] and $^{87}Sr/^{86}Sr$ ratio declined. Genesis 10:25 may refer to a physical division of the continents.[11] However, Cretaceous onwards overriding *increase* in $^{87}Sr/^{86}Sr$ ratio can be related to significant continental erosion and runoff associated with the development of today's greatest mountain ranges. The great volume of North America's Zuni and Tejas megasequences coincides with Cordilleran mountain-building. The diverse composition and provenance of North American Phanerozoic sandstones have been related to

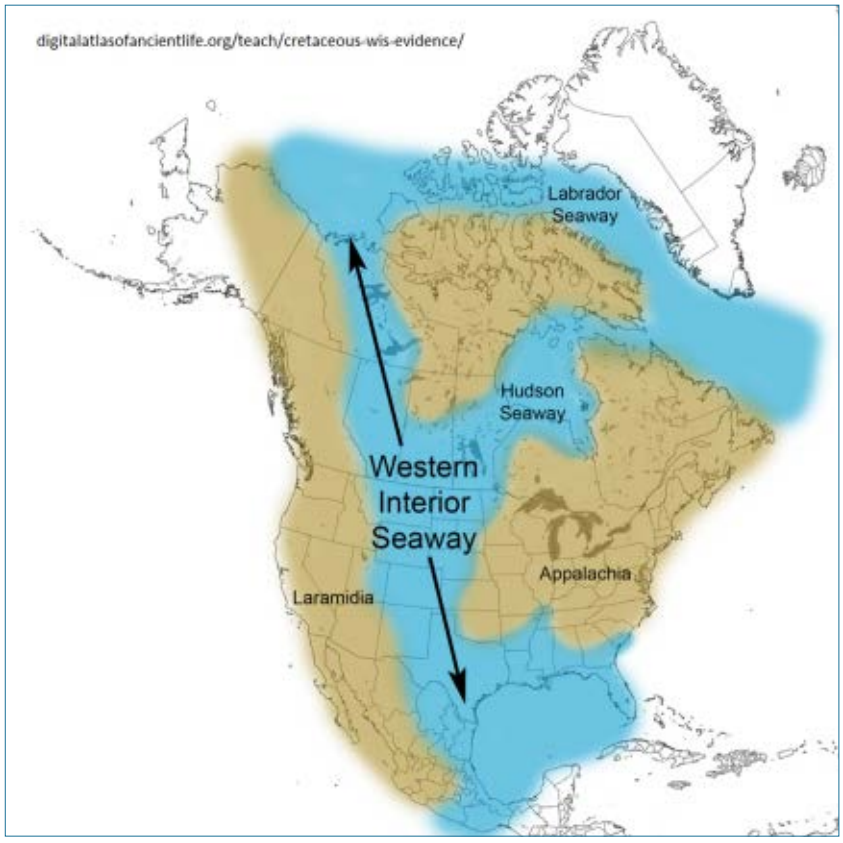

Figure 4. The Western Interior Seaway[18] at its maximum extent extended for 4,800 km and was approximately 1,620 km wide. This seaway formed during the Cretaceous sea level peak (refer figure 2). Water flooded low-lying parts of stable cratonic areas of the world, but did not completely cover the continents. This was during a time of seafloor spreading and continental drift, with hot expanded mid-ocean ridges displacing water onto land.

orogenies including development of the ancestral Rockies.[12]

In Tim's figure 1, the $^{87}Sr/^{86}Sr$ ratio and the sedimentary thickness and volume curves (asserted to be a sea level curve) correlate because both curves are a function of detrital runoff.

Conclusion

It is helpful to also consider stratigraphic data such as biota, fining upward succession, geochemistry, sedimentary facies, and lithologic associations, along with tectonic setting.

The Bible's account of Noah's Flood covers more than just the marine transgression stage. Figure 2 shows a proposed model which refers to a variety of stratigraphic information. It is important to distinguish stages evident from both Scripture and the rock record. This proposed model is intended as food for thought and to stimulate further research.

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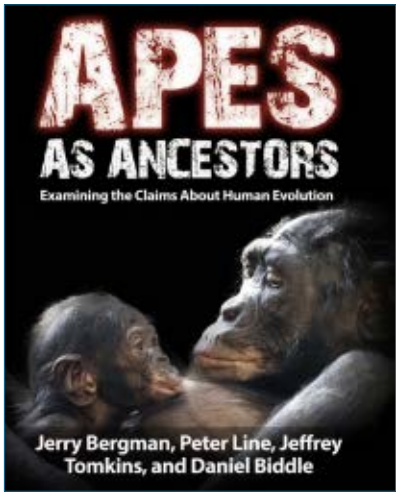
Human evolution remains non-factual

Apes as Ancestors: Examining the claims about human evolution

Jerry Bergman, Peter Line, Jeffrey Tomkins, and Daniel Biddle

BP Books, Tulsa, OK, 2020



John Woodmorappe

This recently published book is a one-volume encyclopedia of claims of human evolution, and is quite detailed and fairly technical. Besides examining the standard extinct primates that are enlisted as part of evolutionary scenarios, it also focuses on seldom-considered factors that separate humans from non-human primates, both in terms of biology and behaviour. In addition, this work offers a creationist explanation for the fact that modern *Homo sapiens* is noticeably different from the likes of *Homo erectus* and Neanderthal Man, and relates these differences to the teachings in the Bible.

The authors Bergman, Line, Biddle, and Tomkins, are well qualified to examine questions related to presumed human evolution. Bergman, Line, and Tomkins have strong backgrounds in anatomy and physiology, and Peter Line has a strong background in neurobiology. Their analysis of the paleonthropological literature is exhaustive.

Fragmentary and incomplete skeletons

The 'pre-human' specimens found so far are far from ideal. Bergman reminds us that, "Most claimed fossil ape-men finds consist of a few teeth plus pieces of broken skull and other bone fragments" (p. 26). For instance, *Ardipithecus* ('Turkana boy') is exceptional in that its skeleton is 40% complete. The much-hyped australopithecine Lucy is fragmentary, and only 20% complete by skeletal weight (Bergman and Biddle, p. 104). The habiline KNM-ER 1470 is notorious for its fragmentary character, leading to ever-changing reconstructions and ensuing interpretations (Peter Line, p. 187). *Homo erectus* is difficult to evaluate because of the rarity of post-cranial elements, especially those that can unambiguously be linked to the crania (Line, p. 246).

Illusory 'grab bag' taxons

Some of the taxons are each a 'wastebasket'. The understanding of extinct primates, and their presumed role in the evolution of humans, is complicated by the fact that some of the names used are, or may be, an amalgamation of skeletal remains of different animals, and even of non-humans and humans. This is true, for example, of so-called *Australopithecus sediba* (Editors, p. 3, Peter Line, p. 134) and *Homo habilis* (Peter Line, p. 198). The latter is an admixture of australopithecines, *Homo erectus*, and the skeletal remains of oddball extinct primates of unclear affinities. In addition, the presence of nearby tools influences the naming of specimens (e.g. *habilis*), even though the identity of the toolmakers cannot be proved. In addition, toolmaking, even if it could unambiguously be linked to specific skeletal elements, is less diagnostic of 'human-ness' than previously supposed. We now know that chimps make and use tools of varying sophistication, but this of course does not make them any more human-like.

Conflicting interpretations

The conventional evolutionary scenario is as follows: The australopithecines were succeeded by *Homo habilis*, which in turn was succeeded by *Homo erectus* and then *Homo sapiens*. Paleoanthropologist Bernard Wood rejects this simple unilineal model of human evolution, basing his conclusion on both fossil morphology and evolutionary dating methods (Peter Line, p. 201).

Some paleoanthropologists question: the significance of absolute cranial capacity, the inferring of language function from skeletal elements, and the inferring of the ability of precision gripping (Line, p. 173). Differing interpretations of newly discovered skeletal elements are common. For instance, evolutionists disagree on whether *Oreopithecus* was bipedal (Line, p. 92).

Let us take a closer look at cranial capacity. Evolutionists see the crude trend towards greater cranial capacity, in the inferred lineage leading to humans, as evidence of increase in intelligence with time. However, evolutionists admit that, among modern humans, there is a wide range of cranial capacities, and that such cranial capacity has no relationship to intelligence. They get around this paradox that they had created by claiming *ad hoc* that cranial capacity was once associated with intelligence, but no longer is. This is special pleading with a vengeance! (Line, pp. 242–244).

Let us consider closely-related traits. It should be noted that there is an unexpected considerable overlap, in cranial-vault thickness, of *Homo erectus* and modern *Homo sapiens*.[1]

The irrelevance of bipedalism in 'pre-human' primates

Evolutionists and the media put much hype into claims that (inferred) bipedality in certain extinct primates means that this alone makes them quite 'human-like'. It does not.

In actuality, extinct primates fill in a lot of morphospace that is left empty by only considering today's apes and humans. It is therefore not surprising that some 'human' traits (such as bipedality), so designated because they are found only in extant humans but not in extant apes, turn up in extinct primates. Consistent with this fact, *Oreopithecus*, *Rudapithecus*, and *Danavius* appear to exhibit a type of bipedalism, even though no evolutionist considers them closely related to humans, or on the evolutionary path to humans. Moreover, their bipedalism, according to the evolutionistic timescale, precedes the first hominids by several million years (Peter Line, pp. 92–93). From an evolutionary point of view, they can be seen as early evolutionary 'experiments' in primate bipedalism, but they reduce the presumed significance of bipedalism in the primate-to-human lineage. From a creationist viewpoint, the sheer variety of quasi-bipedal extinct primates bespeaks a common phenomenon among extinct primates, and not something special that occurs only in those extinct primates enlisted to support evolutionary scenarios.

Putative non-human primate bipedalism is also theologically irrelevant. Peter Line comments: "The Bible does not address the issue of locomotion in primates, and so, from a creation viewpoint, if bipedal ape-like primates existed, it does not contradict Scripture" (Peter Line, p. 91).

How to count differences in members of genus *Homo*

Differing interpretations often cloud the picture. For instance, Neanderthal Man was originally portrayed as brutish and stooped-over, consistent with ruling evolutionistic preconceptions. Now we know better (Bergmann, p. 280).

Some of the distinctions in taxonomic classification of *Homo* are based on circular reasoning. Consider the Xuchung, China, crania, which are large-brained but otherwise very similar to classic *Homo erectus*. Line comments:

> "However, if crania are ruled out from belonging to *Homo erectus* simply because of a large cranial capacity, then you will end up with a species of only small-brained individuals, but this leads to circular reasoning. The faulty logic produces this circular reasoning: crania are ruled out from belonging to *Homo erectus* if they have large cranial capacities, and then evolutionists use this as proof that there are no *Homo erectus* crania with large cranial capacities" (Line, pp. 232–233).

So part of the differences, as between *Homo erectus* and *Homo sapiens*, are artifacts of which specific fossils are assigned to *Homo erectus, Homo neanderthalensis, Homo heidelbergensis,* and which to *Homo sapiens*. In addition, what counts as a difference largely depends on how uncommon a feature has to be in today's *Homo sapiens*, compared to its abundance in *Homo erectus*, in order to be counted as a difference (Line, p. 229).

There is also the factor of time. Consider the Willandra Lakes hominids of Australia. They are dated, according to evolutionary dating methods, to only 12,000 to 30,000 years old, which is a blink on the evolutionary timescale. Yet they look astonishingly similar to much, much older *Homo erectus* specimens (Line, p. 237). So what are they?

A creationist explanation for the differences in the genus *Homo*

Consider the implications of the likelihood that almost all the forms assigned to genus *Homo* are of one species. If *Homo erectus*, Neanderthals, and modern humans are just racial variants of each other, why are they different from each other, and why especially are modern humans different from the various fossil specimens of *Homo*? To begin with, Peter Line writes:

> "Likely, some of the differences in the crania between *Homo erectus*, *Homo heidelbergensis*, and Neanderthals may simply be due to differences in brain size and/or a relatively minor difference in brain growth rate, as the brain growth largely determines the size and form of the neurocranium" (Line, p. 231).

As for modern *Homo sapiens*, Line adds:

> "I believe that the Neanderthals were fully human, that is, descendants of Adam and Eve, as were the individuals that make up what evolutionists classify as *Homo erectus* and *Homo heidelbergensis* … . The few differences were caused by factors such as human variation, genetic drift, as well as environmental influences. Why *Homo erectus*, *Homo heidelbergensis*, and Neanderthals were more different from anatomically-modern humans, than from each other, requires further explanation. One explanation as to why they were different in morphology compared to modern humans, particularly in the skull, could reflect changes in development of these early, post-Flood, individuals compared to modern humans … possibly related to longevity" (Line, p. 321).

In terms of technical details, Line explains:

> "Evolutionists have no problem incorporating changes in growth rates to explain some of the differences in skull features between modern and robust humans. For example, acceleration in the longitudinal growth of the cranial base early in the development of the Neanderthals has been speculated to, ultimately, because of a longer and flatter cranial base, 'have impacted

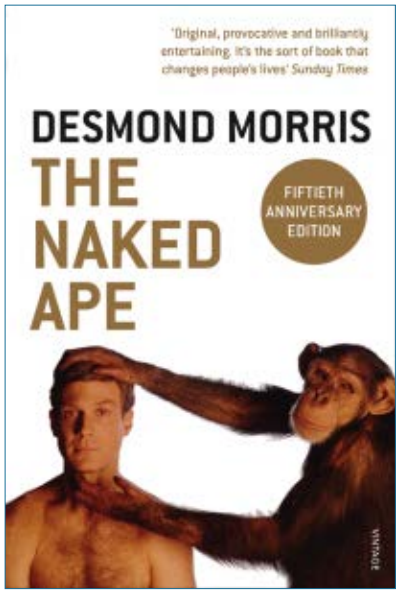


Figure 1. Differences between humans and apes are huge. The human is in no sense a 'naked ape', as portrayed here.

both vault and facial shape, and may have been responsible for many of the craniofacial differences between Neanderthals and modern humans.' Arguments have been made with respect to the face, that some of the most significant differences in facial features including 'massive, protruding supraorbital tori, their prognathic faces, and their receding, chinless mandibular symphyses' is what distinguishes modern human faces from *Homo erectus* and *Homo heidelbergensis* …" (*ibid*, p. 234).

Other factors that could explain at least some of the differences in ancient and modern *Homo* are diseases in fossil organisms. These diseases include microcephaly and cretinism.

Humans and chimps are in no sense 'almost the same'

Books such as *The Naked Ape* (figure 1) have promoted and reinforced the notion that humans and chimps are astonishingly similar to each other. They are not. Tomkins and Bergman (p. 58) point out that chimps and humans cannot interbreed, that chimp organs cannot be transplanted to humans, that chimps cannot read and write, and that chimps do not bury their dead or conduct funerals. Humans can convey over 1,000 different facial expressions, as against less than a dozen in chimps (Bergman, p. 33). Even the 'nakedness' of the 'naked ape' is ironic in a way. Among primates, humans have a unique dearth of body hair, and evolutionists have a myriad of conflicting hypotheses as they try to account for this salient fact (*ibid*, p. 44).

Let us now focus on genomic characteristics. The much-hyped evolutionistic claim that the DNA of humans and chimps is 98% identical, is false. It turns out that this is based on a comparison of only already-similar DNA sequences in both genomes. When the entire DNA sequence of both is compared, the number drops to 81–84% (Tomkins and Bergman, p. 61). But all this is academic: similarities and differences in DNA may be a foundation of sensationalistic evolutionary arguments and media narratives, but they tell us very little about the relative capabilities of different creatures. The venerable creationist Duane T. Gish once pointed out that clouds are 100% water and watermelons are 98% water, but that hardly means that both are essentially the same.

Now consider chromosome structure. Of all the chimp and human chromosomes, two chimp chromosomes are inferred, by evolutionists, to have fused to form one corresponding chromosome in humans. In actuality, the corresponding similarities between the human-chimp chromosomes are doubtful, and the 'fusion point' is actually functional (*ibid*, pp. 63–64).

What about genes? There are thousands of genes found in humans but not found in chimps, and thousands of genes found in chimps but not humans. These are called 'orphan genes' (*ibid*, p. 66).

Conclusions

Human evolution continues to be beset with problems, such as fragmentary and incomplete remains, indefinite taxa, and over-interpretation. These problems add up, as elaborated by retired biologist Willard Lake:

> "A major problem in the field is, as Mark Twain is reported to have stated, the evidence in the paleoanthropology field consists of a few scraps of bone and a few tons of plaster to fill in the missing parts. The authors conclude from their review, documented in over 5,000 endnotes … that all of the 'hominid' fossils so-far discovered are either some kind of misidentified monkey, ape or human [or hoax]. No example reviewed is convincingly shown to be an intermediate link bridging primates to humans to support the view that mankind and apes have a common ancestor, which was some kind of simian. Remember, the range of physical traits in both simians and humans is wide, and all of the examples researched in this book fit neatly in either one category or the other" (p. v).

The differences between modern and ancient *Homo* do not require evolution, and may be explicable by such things as differences in aging soon after the Flood. However, owing to the fact that some of these differences occur among juveniles, the differences in modern and ancient *Homo* must also include a difference in the timing of development, and not simply a longer lifespan for early-postflood man. All this should definitively be further explored as part of a more comprehensive creation model.

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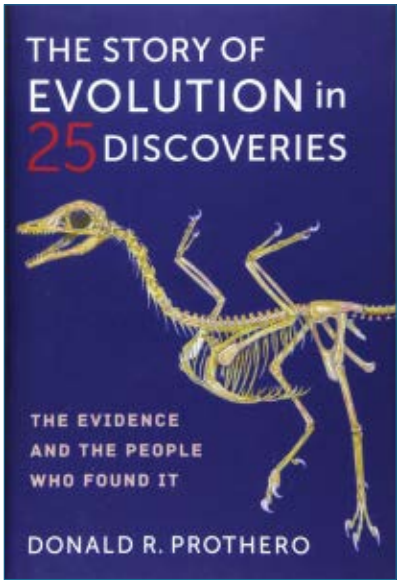
A very doctrinaire evolutionist rehashes all the canned arguments

The Story of Evolution in 25 Discoveries: The evidence and the people who found it

Donald R. Prothero

Columbia University Press, New York, 2020

John Woodmorappe



Author Don Prothero is a capable spokesman for evolution. He teaches geological sciences at California State Polytechnic University and is a research associate at the Natural History Museum of Los Angeles. In this book, Prothero's evolutionistic triumphalism is manifested, for example, by his reviving of Theodosius Dobzhansky's old nonsense that "Nothing in biology makes sense except in the light of evolution." He should tell that to Linnaeus, Mendel, and countless other pioneering pre-Darwinian and Darwin-era biologists, all of whom made perfect sense of living things without evolution.

Hoary rationalistic myths

Prothero adheres to the thoroughly discredited Draper–White dialectic model of the conflict of science and religion, in which scientists are the enlightened good guys and the religionists are the obscurantist bad guys. His evolutionistic triumphalism is juxtaposed with the straw men he makes of the creationist position, on which I elaborate shortly. The author also sneers at things not to his liking that have nothing to do with evolution, special creation, and science. For instance, he makes a partisan statement on US presidential politics (pp. 332–333).

The author assures us that the medieval conception of Earth was a flat disk surrounded by a solid dome (sky). We hear the old saw about Columbus sailing in a world that was flat and being pleasantly surprised to discover that it was not. This should be enough to discredit the book, because it has long been known that hardly any Christians have ever taught a flat earth in the entire history of the church. Then came the glorious so-called Age of Reason. We are told that James Hutton pioneered uniformitarianism during the Scottish enlightenment, and that this enlightenment happened in Scotland because the church was weak there.

Finally, there are all the straw men about creationists. We rehear the canard about millions of animals on Noah's Ark. We are told that creationists suppose that every living thing exists on Earth exactly where it was first created (wow!)—which was actually the teaching of the uniformitarian (and anti-Bible) Charles Lyell. Better yet, the earth is perfect, unchanging, and looks exactly today as it was the day it was created. Best of all, humans, in Prothero's imagination, are the centre of the universe.

The fossil record

Prothero correctly notes that evolutionists no longer think in terms of a 'ladder of life'. Rather, living things presumably evolve as groups in 'bushes'. He discusses many forms of 'transition-filled' evolution, such as 'walking fish', dinosaurs to birds, horses, walking whales, etc. In common with virtually all other evolutionists, Prothero confuses mosaics with transitional forms. He is also silent about the many specializations found among fossil organisms in the evolutionary bushes. Finally, his presentation is very superficial, and he overlooks the many discontinuities and trait reversals (from 'primitive' to 'derived' and back to 'primitive' again) that are found in the evolutionary 'bushes'. Ironically, he diminishes the presumed significance of the Devonian 'walking fish' when he points out that there are not only fish today that walk on land, but whose ambulation on land is improved by selective breeding (p. 148).

Ontogeny does not recapitulate phylogeny

Prothero gets this right:

"For example, many features of embryos (especially embryonic organs such as the placenta or the yolk sac) are not features of the adults, so the embryo is not the same as the functioning adult organism. In particular, the embryonic mode of life is very different than the adult mode of life, so the fish-like embryo of a mammal is not an actual fish that could survive as an adult. In addition, *there is never complete correspondence*

between an embryo and the adult of a fish. The chick embryo at one stage may have a heart and circulation like that of a fish, but it lacks most of the other things found in adult fishes. Many of the features that are fixed in adults are only transitory in embryos. Sometimes, parts that should occur later in development appear unusually early, such as the backbone in the chick embryo [emphasis added]" (p. 65).

However, not to be denied, Prothero persists in this kind of old thinking. His chapter 5 is misleadingly titled, "Ontogeny recapitulates phylogeny". He is dismissive of Haeckel's fraudulent drawings, and insists that even the few piscine features in a mammalian embryo prove evolution. However, from Prothero's quoted statements, it is evident that any 'fish stage' in mammalian development is, at best, based on special pleading (noticing piscine features in the embryo while overlooking the lack of many other piscine features). At worst, it is an exercise in the imaginative "reading in" of evolution into embryological development.

Embryological interpretations, and homology, were first creationist concepts

Ironically, 'embryological recapitulation', and similarities between organisms, were known and appreciated long before Darwin. Prothero comments: "However, it was not considered evidence of the evolutionary past of the embryonic animals, but just a God-given 'pattern of unification' that reflected the unity of nature" (just as homology was originally seen before 1859, chapter 4).

Parenthetically, Prothero thereby shoots down his own repeat of Dobzhansky's silly argument that "nothing in biology makes sense except in the light of evolution." By his own tacit admission, it most certainly does!

Microevolution does not cause macroevolution

Prothero spends much time discussing relatively trivial changes in organisms (such as the beaks in Darwin's finches). He gives many examples of what he calls "rapid evolution".

The author then turns around and admits that these may have nothing to do with the presumed evolution of higher taxonomic categories. He comments:

"We have gone from the neo-Darwinian insistence on every gene gradually changing to make a new species to realizing that only a few key regulatory genes need to change to make a big difference, often in a single generation. This circumvents many of the earlier problems with ideas about macroevolution. *It is possible that the processes that build new body plans and allow organisms to develop new ecologies are not the product of small-scale microevolutional changes extrapolated over time.* Some evolutionists still see evo-devo as just an extension of the neo-Darwinian synthesis, but others argue that it an entirely different type of process from that envisioned in the 1950s [emphasis added]" (p. 259).

Evolutionary preconceptions governed—and ended—the Piltdown Man hoax

It is often pointed out that the Piltdown Man forgery was long accepted without question because it fit the ruling evolutionary notions. Prothero goes a step further. He points out that the Piltdown Man hoax did not get exposed until *it no longer fit* the ruling evolutionary views! He writes:

"They were also misled by 'Piltdown Man', a hoax first announced in 1912 that was put together from the skull of a modern human and the jaw of an orangutan cleverly broken in the right places and stained to make them look ancient. The forger (amateur archaeologist Charles Dawson and possibly some accomplices) knew exactly what British anthropologists were expecting, so he used a large-brained medieval human skull and a modern orangutan jaw to make it seem plausible to the anthropologists of that time. It was the pride of the British anthropological establishment for years, often proudly described as 'the first Briton'. The Piltdown forger was exposed in 1953 as more and more discoveries from Africa showed that humans first evolved there, so the Piltdown 'fossil' no longer made sense" (p. 315).

'Piltdown Man' is sometimes spun as an example of the fact that 'evolutionary science is self-correcting'. Is it? The amateurish forgery fooled top evolutionists for only 41 years. Now we must additionally ask the following question: How much longer would 'Piltdown Man' have been accepted as genuine had it not started to conflict with new anthropological evidence?

Biogeography

Donald Prothero discusses the different forms of life on different continents, and gets a bit dramatic, titling a chapter "The Sinking of Noah's Ark". He obviously thinks that only a homogenous distribution of land animals, on all the continents, is compatible with them all deriving from Noah's Ark. This is another straw man.

It is easy to see that Prothero does not bother to go beyond a very simplistic understanding of biogeography. To begin with, we know that sweepstakes routes are very important, that is, routes that have a major barrier and are thus used by only a few animals, so it's a 'lottery' which animals use them. Such routes as these must have been quite pronounced after the Flood, for reasons such as the probable cold interiors of continents because of the post-Flood ice age.[1] Moreover, those animals located on land masses the furthest from Ararat (South America

and especially Australia and the Pacific islands), having gone through the most sweepstakes, should in general be the most biogeographically differentiated. And that is exactly what we find. Finally, we must factor in the introduction of animals by humans after the Flood. Introducing different forms of animal life, in different locations, must have been magnified in impact by the emptiness of large continental areas, and further exaggerated by the remoteness of those land masses located the furthest from where Noah's Ark landed.

Flippant dysteleological remarks

In this book, Prothero puts much emphasis on dysteleology. Bringing up the auditory system in mammals, Prothero asks: "But how did this clumsy and inefficient arrangement develop?" (p. 58). He then repeats the narrative about the alleged evolution of mammalian hearing, in the synapsids, as supposedly recapitulated in embryology. To belabour the point, he asks again: "Why did mammals develop such a clumsy arrangement?" (p. 58).

Never once does Prothero bother to tell the reader why the mammalian auditory system is supposedly 'clumsy' and 'inefficient'. Opinions are not the same as science. 'Clumsy' and 'inefficient' compared with what? And what exactly is Prothero's concept of an "efficient" auditory system, and on what evidence is it based? Prothero is completely silent about this.

The panda's 'thumb' yet again

Prothero compares the function of the panda's 'thumb' with that of the fully opposable human thumb. He comments:

> "It is a patchwork 'thumb' that serves just well enough to strip leaves from bamboo stalks. It is nowhere near as flexible and strong and useful as the opposable thumb of primates, but it doesn't have to be—the panda just needs a device for stripping leaves" (p. 114).

But that is just the point! Why 'should' the panda have a human-like thumb when it does not have to do most of the things that humans need their thumbs for? It would be like suggesting that we use a precision industrial cutting machine in order to open a tin can. Or, better yet, it would be like insisting that the can opener cannot be the product of intelligent design because its cutting tolerances are very poor, and immeasurably inferior to those of the industrial cutting machine.

Ironically, the panda's thumb is, if anything, an embarrassment for evolutionists, not creationists. The panda's 'thumb' is the same in both the giant panda and the red panda, and it was thought to be a distinctive homology that proved a recent common ancestor to both pandas. Prothero comments:

> "For many years, it [red panda] was thought to be a very close relative of the giant panda because it also has the same weird 'thumb' jury-rigged from the radial sesamoid of its wrist and used to strip leaves from bamboo, its main food source … . In earlier days, scientists might have regarded such a specialized paw structure as a truly unique feature and could not have imagined that it could evolve in parallel. But fossil, molecular, and behavioral data cannot be denied, so we are forced to admit that it did so" (p. 116).

So the giant panda is now believed closely related to bears, and the red panda to be closely related to raccoons and weasels.

All this exposes the special pleading that is part and parcel of evolutionary thinking. Similarities in living things prove that they evolved from a common ancestor—except when they don't. Then we have convergence, a reductive *ad hoc* explanation.

The 'poorly designed' human

The author continues his dysteleological dump. He trots out the backwards-retina myth, the one about the 'inelegantly indirect' laryngeal nerve

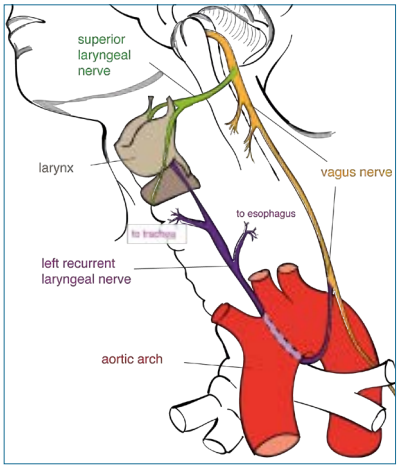


Image: Jkwchui / CC BY-SA 3.0

Figure 1. The laryngeal nerve, a supposed example of bad design, takes an indirect course from the brain, around the aorta, and to the larynx.

(figure 1), the one about wisdom teeth, and the one about hernias caused by the human bipedality that was secondarily imposed upon a quadrupedal ancestor.

Then comes the appendix. Prothero uses rather patronizing language as he writes:

> "Evolution deniers try to salvage this hopeless situation by pointing to some vestigial organs that have a tiny bit of function left in an attempt to discredit this entire line of evidence. But this misses the point. If an organ system is greatly reduced (compared to the *ancestral* condition) and performs minimal function, it is still evidence of a past functional system that has degenerated and thus is not well designed [emphasis added]" (p. 283).

Donald Prothero's argument is laughable. It begs the question about the 'original' function of the organ. Notice how Prothero slips in the word *ancestral*. How can one possibly know what this original function was unless one deduces it by comparing it with other animals, based upon presumed evolutionary ancestries! Only then can he suggest that an organ has 'reduced function'. So the strongest argument for evolution, once again, is the assumption

of evolution. The circular reasoning is obvious.

Let us now focus on the laryngeal nerve (figure 1). Prothero pontificates that it is 'unintelligent design' because if follows an indirect route from the brain, around the aorta, and only then to the larynx. This is supposed to be an evolutionary holdover from our piscine past, illustrating the fact that evolution (unlike the Intelligent Designer) lacks foresight, and that living things do not arise *de novo*. What makes Prothero so sure that the 'excessive' length does not itself have a function, if only in the embryo?[2] If we follow Prothero's logic, we could examine the automobile, and if we find a single wire that is longer than the most direct route possible, we should therefore proclaim that the automobile must not be the product of intelligent design.

What is a minimal-solution system?

Doctrinaire evolutionist Prothero sees living things as barely adequate. Their only sufficiency, after all, is to 'get by' long enough to pass the genes on to the offspring (e.g. p. 116). It is in this spirit that he discusses the human body and all its supposed deficiencies. But how do we recognize a 'barely adequate' design when we see one? Consider the Olympic weightlifter and the Olympic acrobat. Both put stresses on the human body that exceed, by far, those imposed by everyday living and the sufficiency to pass genes on to one's offspring. On this basis, it does not look even remotely like the human body is an example of barely adequate design.

Confusing the issue—what is 'unintelligent design'?

Evolutionists typically try to confuse the issue, which is not whether a living thing was well or poorly designed, but whether a living thing could arise *at all* without a designer. Besides, whether a device is well designed or poorly designed is a matter of opinion. Consider the automobile. What if someone argued that an intelligent designer would surely think up some kind of a noiseless engine, rather than the 'jury-rigged' system of a noise-making engine whose noise must be mitigated by the use of an added-on muffler?

Let's pile on the dysteoleological arguments regarding cars as evolutionists do for living things. The exhaust system and the tyres are vulnerable to puncture; the battery terminals experience corrosion from moisture; and the engine is constantly in danger from overheating and seizure caused by any significant leakage of motor oil. That is why there is an oil-pressure warning light on the dashboard. Yet nobody suggests that the automobile is 'unintelligent design', or a 'minimal solution system'.

Not satisfied yet with his evolutionistic triumphalism, Prothero extends his dysteleological thinking to everyday human function. He goes on and on about podiatrists, chiropractors, etc. Most if not all of the maladies that need such services are the products of living in a modern, sedentary society, or are otherwise the products of normal wear-and-tear, and age. Note that this is true of every mechanical device, whether living or non-living. It has *nothing* to do with design or lack of design!

Automobile brake pads wear out, motor oil has to be replaced regularly, and auto repair shops must always be available in order to deal with both foreseen maintenance and unforeseen malfunctions. If we follow Prothero, we must conclude that the automobile is 'poorly designed', or not the product of intelligent design at all.

Molecular biology

This part of Prothero's book is especially erroneous and outdated. He repeats the old sweeping argument about the uselessness of junk DNA, and is oblivious to the many discoveries of function that have been made in non-coding DNA.

The author repeats the discredited claim that human DNA and chimp DNA are 98% similar. Even if Prothero were correct, it would be a confusion of a metric of similarity with the *essence* of the dissimilarity. To illustrate, a child's scribbling and an artistic masterpiece may use the same canvas and paints, and thereby be at least 98% similar to each other, yet the essential differences between the two are profound. Also, since we have about 3 billion base pairs, a 2% difference would still mean 60 million changes. Yet humans and apes are alleged to have split only about 6 million years ago, nowhere near enough time.

Conclusions

This book repeats all the canned arguments for evolution, as used against special creation and intelligent design. It can therefore serve as a comprehensive reference book on this subject. These arguments are monotonically passed down, from one evolutionist to another, with very little evidence of thinking, much less consideration of alternative explanations.

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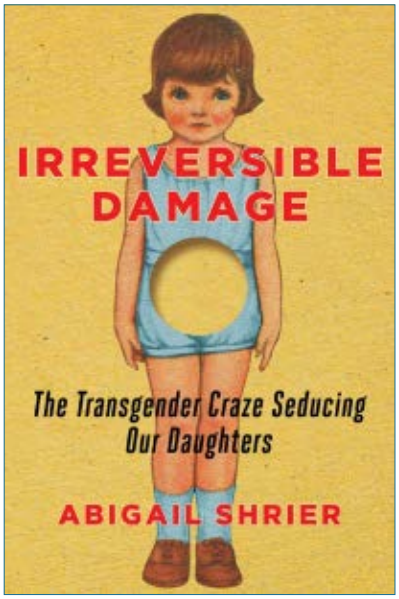
The sex change myth and the dangers of transition attempts

Irreversible Damage: The transgender craze seducing our daughters
Abigail Shrier
Regnery Publishing, Washington, D.C., 2020

Jerry Bergman



It was foundational for almost all of Western history that humans were made in the image of a creator who created us with major 'sexual differences' that produced two different sexes: males and females. As the Bible teaches in Mark 10:6, at the beginning of creation, God "made them male and female. For this reason a man will leave his father and mother and be united to his wife, and the two will become one flesh."

In addition, Genesis 1:27–28 reads, "God created man in His own image, in the image and likeness of God He created him; male and female He created them."[1] Furthermore, Matthew 19:4 says Jesus taught, "from the beginning the Creator 'made them male and female'". This universal teaching, taught as long as humans have existed on Earth, is now being aggressively challenged, partly due to the acceptance of human evolution and the concomitant rejection of Genesis.

It is the modern rejection of the fact that only two biologically different sexes exist that Abigail Shrier (figure 1) has undertaken to explain. A Jewess by birth, she has a degree in philosophy from Oxford University and a law degree from Yale. Her careful, detailed research reflects her academic pedigree.

The new terminology that this movement has created is now part of our vocabulary in the West. Included is *cisgender*, a male person in a male body and a female person in a female body. The other side is a new category, *transgender*, often abbreviated *trans*, the belief that some people end up, for some unknown reason, inhabiting the wrong body. In short, a female person is trapped inside of a male body where she does not belong, and a male person is likewise trapped inside of a female body where he does not belong. The solution is to attempt to change the body to conform to the gender the person believes he or she is. Procedures to achieve this goal include, but are not limited to, surgery, a lifetime of taking powerful hormones such as testosterone, and, in the case of a young person from age 8 to 13, puberty-blocking hormones (p. 163).

Those critical of this transgender belief are often labelled with derogatory terms, such as *transphobic* (literally meaning fearful of trans persons, but now the term is applied to a person who does not approve, or is critical of, the trans belief) or *a genderist*, one who believes only two genders exist when there are actually many genders.

Gender dysphoria is the distress felt by a person due to the real or imagined concern that a mismatch exists between their gender identity and their sex assigned at birth, based on their genitalia. Nearly 70% of all gender dysphoria cases resolve themselves, and the person adjusts to the point where she/he is comfortable with her/his birth sex assignment (p. xxi). Historically, gender dysphoria has affected about 0.01% of the adult population, and the overwhelming number of cases were young males. Before 2012, Shrier was unable to find any scientific literature on female transgender cases from ages 11 to 21. In the last decade, both the number of cases and the dominate sex of gender dysphoria has changed drastically. As of 2021, the vast majority of persons that suffer from gender dysphoria are young females, and the rate has risen from less than 0.01% to 0.6 to 0.7%, or a rate 60 to 70 times higher.

Reasons for the increase are not due to better diagnostic techniques, but an actual change in the rate. One of the most important factors in the rapid growth of genetic dysphoria is the replacement of Genesis with Darwinism, which teaches that sexual differences are due to evolution and culture. Several detailed studies attempt to justify both transgenderism and homosexuality by evolution, such as the classic book by Stanford University Professor Joan Roughgarden, who underwent sexual reassignment from male to female.[2] Another example is Bruce Bagemihl, who, in 751 pages, documented that homosexual, bisexual, transgender and even intergenerational sexual behaviours are common in the

animal kingdom.[3] Therefore, Bagemihl extrapolates, since such behaviour is normal, thus acceptable, for animals, it is also normal for humans. This belief is clearly founded on the evolutionary view that humans *are* mere animals and are thus not significantly different to animals, in contrast to the biblical teaching that humans were created male and female in God's image.

The many reasons Shrier documents that account for the transgendered girls' rate increase include the numerous trans support groups, mass media support that implies the condition is genetic, and social tolerance demands that we accept both the condition and the lifestyle. Another factor includes the LGBTQ (an acronym for lesbian, gay, bisexual, transgender, and queer or questioning, meaning one is not sure what sex one is) movement and education in government schools which, at the least, forces students to think about the possibility of being gender dysphoric.

This influence is similar to nursing students who become concerned that they suffer from the symptoms of some of the diseases they study. Shrier adds that another factor is "K-12 indoctrination in gender ideology that is both so radical and so pervasive that it is hardly surprising that so many kids might want to take cover under an LGBTQ umbrella." (p. 70). LGBTQ education also openly attempts to normalize what were formerly widely considered disapproved sexual deviations (p. 68).

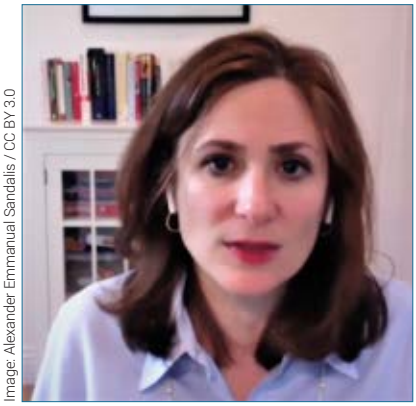


Image: Alexander Emmanuel Sandalis / CC BY 3.0

Figure 1. The author, Abigail Shrier, who created a storm of protest due to her book's politically incorrect conclusions.

Another factor is media glamourization of both the legitimacy of the transgender claim and their lifestyle. A recent example is 68-year-old Bruce Jenner, who transitioned into Caitlyn Jenner (figure 2). 'She' was featured on the cover of leading magazines, including *Vanity Fair* and *Sports Illustrated*. (p. 31). In Jenner's case, achieving the transformation required not only hormone treatment, but extensive plastic surgery, make-up, and skillful photography to produce pictures that make her appear to be a very attractive woman. It also ended a 23-year-old marriage. On close examination, the Jenner makeover was actually somewhat superficial. Jenner's appearance was still very masculine, and he retained the deep male voice and other traits that he had had as a male.

Diagnosis of transgender

Normally, a patient describes his/her symptoms to a doctor, and the doctor is charged with making the diagnosis. In the case of gender dysphoria, there exists no consistent, observable diagnostic criterion (p. 164). The condition exists in the person's mind or imagination; they *believe* that they are a male trapped in a female body. In this case, the patient makes the diagnosis and tells the doctor his/her conclusion. This largely subjective process, allowing a 13-year-old girl to conclude she is really a he, lends itself to many abuses. Shrier documents the many abuses of this movement using case studies and references to the peer-reviewed literature. Patient self-diagnosis is similar to an anorexic who tells her doctor, "I am too fat and need to lose another 10 pounds." The doctor, while looking at a 5-foot-8-inch-tall girl who weighs 80 pounds that reminds him of an Auschwitz-camp survivor, responds to her self-diagnosed conclusion, "I think I have a diet that will help you lose another 10 pounds without much trouble."

Hormone therapy

For girls, the main hormone given is testosterone, often by injection at levels from ten to forty times the level that their bodies normally produce. The effects of long-term testosterone use in girls are unknown. The short-term effects include, besides pain, reduction of short-term memory, increased moodiness, painful vaginal atrophy, and an increased risk (about 5 times) for cardiovascular problems, including stroke, heart attack, diabetes, blood clots, and even cancer (pp. 49, 166–171).

The goal of taking testosterone is to cause the development of male sex characteristics (growth of body hair, especially facial hair, a rounder nose, squarer jaw, deeper voice, growth in skeletal muscles, etc.) and to cause the suppression of female sex characteristics. Complications include that her voice may crack, and she may develop acne and even male-pattern baldness. Some women elect to have a mastectomy, hysterectomy, and an oophorectomy (p. 171). On the other side, injection of testosterone (called 'T'), as is true of many addictive drugs, often causes euphoria, a 'high', and produces a drug joyride. Some shoot up 'T' for the effects alone (p. 166). In 2007, one gender clinic distributed 'T'. Now it is available in over 50 clinics, including Planned Parenthood, to meet the demand.

Chemical castration

The common puberty blocker Lupron is considered an essential first step for a prepubescent child in the transitioning process. It is FDA approved for halting precocious puberty only, such as a five-year-old

Figure 2. Caitlyn Jenner, the star of the transgender movement. She still has many obvious male traits in spite of extensive make-up and dress.

girl who begins developing breasts. It works by blocking pituitary hormone production. For gender dysphoria it is given 'off label', meaning its administration for that purpose is currently not backed by credible valid research (p. 164). The research shows it is a powerful drug that interferes with both primary and secondary sexual development. Its use does not significantly alter the pre-sexual body when given beyond the age of 13 or 14. Conversely, it interferes with the brain's development if given before normal brain development is complete, around age 25.

The use of the Lupron procedure as part of a sex change program is, at best, experimental guesswork. No information exists for the long-term effect of this drug for puberty blockage, positive or negative.

The next step is to give the female male hormones, a problem because sexual development for both males and females requires the proper cocktail of both male and female hormones. Injection imbalance creates problems.

Genetic differences

All *normal* males are XY and all *normal* females are XX. Thus, given 50 trillion cells in the human body, chromosomally 50 trillion genetic differences exist between normal males and females. Furthermore, a process called imprinting occurs at the early stages of human development, causing hundreds of genes to be turned off epigenetically in males and another, different set of hundreds, to be inactivated in females. The result produces well over 500 trillion genetic differences between the sexes.

Another imprinting process also occurs in a parent-of-origin-specific manner. So far, 228 genes are known to be parent-of-origin-specific imprinted in humans. This means the effects of the gene depend on *the parent* who passes it on to their child. If passed on by the father a very different outcome results than if the gene is passed on to the child by the mother. Partial imprinting also occurs when alleles from parents are *differently expressed,* depending on the genetic environment of the gene, rather than a complete expression or complete suppression of one parent's allele. This brings the differences between males and females up to something like 114,000 trillion. Not a single trait has been found to be identical in both males and females.[4] These factors are one of many reasons why so-called transitioning from one sex to another involves only largely superficial changes. The differences between males and females are not due to hormone differences only, but the male/female genome. This genome even produces skeleton differences.

Skeleton differences

Another clue to why many of the changes due to hormone treatment are superficial is found in the skeleton. An adult skeleton displays numerous sexual differences, including the fact that the male skeleton has, on average, 50% more bone mass to support their larger size and their average of 36% more muscle mass. Before the recent epidemic of obesity, the average American male weighed 75 kg (166 lb) and was 1.6 m (63 in) tall. In contrast, the average female was 63.5 kg (140 lb), a difference of 12 kg (26 lb). Furthermore, females were an average 15 cm (6 in) shorter.

Other differences include that the male skull is thicker, his forehead more sloped, the mastoid region behind the ears is more pronounced, and his jaw squarer (p. 162). To reduce these differences requires testosterone injections long *before* age 6. However, almost all transition attempts occur after age 6, usually after age 12 or 13, when the secondary sexual characteristics have already been a central part of development.

The cause of transsexualism

Since no evidence exists of a biological basis for the belief that someone is living in the wrong body, the cause is almost certainly due to social and/or environmental and/or spiritual factors, especially early life experiences. Shrier notes that there occurred a sudden spike in transgender identification among mostly white teenagers assigned female at birth during the 2010s. She attributes this spike to a social contagion, especially through the internet, among highly anxious, depressive girls who, in previous decades, fell prey to anorexia and bulimia or even multiple personality disorder (pp. 142, 213).

Other influencing factors include social isolation, online social dynamics, restrictive gender and sexuality labels, unwelcome physical changes, and unwelcome sexual attention. Shrier also blames the so-called gender-affirming psychiatric support for encouraging the transsexual craze. They have often supported experimental hormone replacement therapy and sex reassignment surgery, often calling it gender-affirming care, as 'treatment' for gender dysphoria in young people. Shrier began to investigate adolescent-onset gender dysphoria after being

Figure 3. Johns Hopkins University when founded in the 19th century. A study at Hopkins showed that psychosocial adjustments of surgically treated transgendered people were no better than those who did not have the surgery.

contacted by the mother of a young female with no known history of childhood gender dysphoria who first identified as transgender in college.

Johns Hopkins University established a Sex and Gender Clinic in 1971. Dr Paul McHugh, former chief psychiatrist at Johns Hopkins Hospital (figure 3), launched a study comparing the outcomes of transgendered people who had the surgery with those who had not. He found most of the surgically treated patients' subsequent psychosocial adjustments were no better than those who did not have the surgery. As a result, Hopkins stopped doing sex-reassignment surgery (pp. 140–142). Due to social pressure, they now again do the surgery.

The end of the craze, Shrier concluded, will be patients suing their doctors after they realize that they were mutilated, are now sterile and will never have a family, are addicted to drugs, and are very unhappy. Another scenario is that doctors will be sued by the parents of trans girls who, in desperation, committed suicide (p. 142). An entire chapter is devoted to the many cases where girls and parents are forced to ask, "What have I done to myself and my body?" after transiting attempts (Chapter 10: *The Regret*, pp. 185–204). She also describes transgender persons who became disabled or grossly disfigured after failed surgery and profiles detransitioned young women, transphobia, and conversion therapy.

Case histories include teenagers who questioned their gender identities or came out as transgender while experiencing mental health or personal issues. Other case histories involve parents distressed by their children's transgender identification or transition, rapid-onset gender dysphoria, and the ensuing controversy. Online trans influencers encourage youth to identify as trans, experiment with breast binding and testosterone, and to disown or lie to family members unsupportive of their transitioning and to stand against the influence of parents who oppose their daughter's new lifestyle. Shrier also discusses the problem of male athletes competing in girls' and women's sports.

Summary

This book is a must for those interested in the current transgender fad. The book is thorough, its research is clearly written and is not biased as the popular media claims. The author listened to both sides and presented her findings with great care and sympathy. As of this writing, the book had 3,046 ratings on Amazon, 91% were 5- or 4-star. In short, the author presented a detailed, well-documented analysis of the transgender movement in the face of howls of outrage and even death threats. The problem is primarily a result of the rejection of the Genesis teaching, as supported by biology, that only two sexes exist, male and female. The belief that humans evolved from some apelike common ancestor has been a major factor in the rejection of the two sexes belief. Transitioning from one sex to the other is a myth. One can only produce this illusion based on superficial *outward* changes.

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An incomplete discussion

Three Views on Christianity and Science

Christopher Reese and Paul Copan (Eds.)

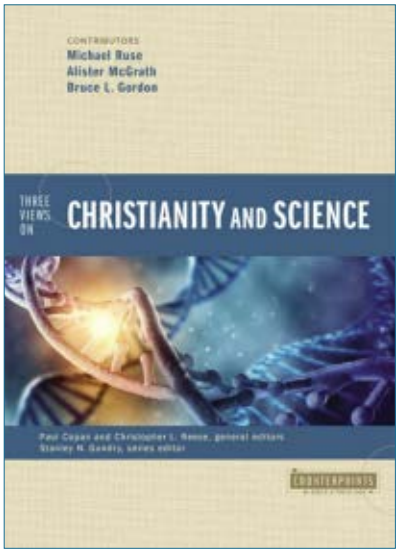
Zondervan Academic, Grand Rapids, MI, 2021

Shaun Doyle

How do the Bible and science relate? What place does 'methodological naturalism' (MN—limiting explanations of natural phenomena to natural causes) have in the proper practice of science? Is science the only way to know anything? What about miracles? Can we use science to argue for God and Christianity? What role did God have in human origins? The relationship between science and Christianity is a multifaceted and complex phenomenon. And there are many different visions of how they relate, both within the church and without.

Capturing that spectrum is not an easy thing to do. Editors Christopher Reese and Paul Copan opt to use the famous attempt of Ian Barbour. He proposed a four-part taxonomy for the relation between science and 'religion': conflict, independence, dialogue, and integration. However, since this is a *Christian* book, concerned mainly with how *Christians* see the relation, the conflict view is set to the side. But not without reason: despite its popularity, it is based on faulty philosophy[1] and an even faultier understanding of history.[2]

So, we are left with three. And thus, three contributors. Championing independence is Michael Ruse, former Lucyle T. Werkmeister Professor of Philosophy at Florida State University and professor emeritus at the University of Guelph in Canada. For dialogue, Alister E. McGrath, the Andreas Idreos Professor of Science and Religion, University of Oxford, director of the Ian Ramsey Centre for Science and Religion, and Gresham Professor of Divinity. And for a form of integration, Bruce L. Gordon, Associate Professor of the History and Philosophy of Science at Houston Baptist University and a senior fellow of the Center for Science and Culture at Discovery Institute.



Michael Ruse: independence

Ruse was an odd pick for this volume, since he is not a Christian. He describes himself as an 'agnostic' (although he prefers 'skeptic') (p. 19). Nonetheless, his essay is perhaps the most entertaining of the book. It is an amusing romp through the subject from an 'independence' perspective (figure 1).

'Independence' for Ruse means Christianity and science have no relation. Science is all about reason and evidence, whereas religion is about 'faith'; a non-rational leap in the dark.

This leads to some interesting consequences. For instance, Ruse is not worried about apparent conflicts between the Bible and science. What should we do with them? "Ignore them!" (p. 22). For Ruse, there cannot be any conflict between the two since the Bible is not about science. It is just about 'faith'.

Does Ruse reject God because of science? No. He regards MN as a rule for science, but it also limits science. Science cannot answer the big questions, like 'Why is there something rather than nothing?', 'What is the ultimate foundation for morality?', 'What is consciousness?', and 'What is the meaning of it all?' He rejects Christianity because he rejects its answers to *these* questions, which are theological and philosophical, not because of some conflict with science.

As such, Ruse has little time for the 'God' of natural theology. God cannot be *proven* by reason and evidence. It may teach us a lot about God and our possible relation to him, but it cannot lead us to God. You just have 'faith'. Or not, as is the case for Ruse.

For Ruse, 'God' is an 'I don't know what' so wrapped in mystery that, if you have 'faith', all the paradoxes fade into insignificance in its light. Even the problem of evil, which Ruse clearly considers a powerful objection against God. After all, 'faith' is like falling in love; it is an unconditional awareness of the transcendent. Ruse's only problem with that sort of 'faith' is that he simply does not have it.

Miracles? They do not matter to Ruse. They cannot be proved to his satisfaction. But even if they could, he would not see any religious significance in them. Attempts to show that Jesus' resurrection really happened? He calls them "bad science, bad history, and bad philosophy" (p. 40).

Human origins? He knows that if you need God for it, you're no longer doing science. And he's pretty confident that a natural explanation will suffice. He explores a few ideas that suggest evolution progresses toward humans. His basic assessment of these proposals? "Basically, the more Darwinian you get, the less likely you are to get humans" (p. 45).

But ultimately, it does not matter for Ruse. Science will do its thing regardless of faith, and faith can see an eternal value in it. That is what faith, what Christianity, should do.

Interaction

The reactions from Gordon and McGrath to Ruse's essay seem to be as much a feature of their contrasting temperaments as they are a reflection of their contrasting views.

McGrath was genteel, though he demonstrates some of the strengths of his own 'dialogue' perspective compared to Ruse's 'independence' model. Gordon, however, goes toe-to-toe with Ruse, and for the most part deconstructs Ruse's view quite effectively. Ruse's rejoinder most mused on how "I and they are so very much in different worlds, paradigms if you like. They are believing, practicing Christians" (p. 70). For Ruse, science is primary, and constrains what religion can say.

Alister McGrath: dialogue

McGrath's essay is a *tour de force* of contexualization; one is not short-changed on the history of Western thought on Christianity and science. But how can McGrath turn that into a *constructive* dialogue relating science and Christianity (figure 2)? That is the burden of his essay.

First, McGrath points out that the relationship between Christianity and science has had a complex history. The relation has often been oversimplified. He considers Christianity and science to be distinct ways to understand the world, but they can interact in a critical and constructive *dialogue*. This is not just a friendly chat between chaps. It is a hard, long look at the commonalities, strengths, and weaknesses of each as we seek to build towards a more unified knowledge base of reality.

So, McGrath says we need to recognize that each field develops its own methods of inquiry shaped for dealing with its unique subject matter. For science, 'methodological naturalism' is one of them (p. 79). But this does not limit reality to what can be uncovered this way. Basically, once we're not using MN, we're no longer doing science. Theology has its own unique methods for investigating reality; they are simply different from science. But since both fields speak to the same reality, they can and do interact.

But *how* do science and theology interact? McGrath speaks of different metaphors. His preferred one is the 'two books' metaphor. In other words, the 'book' of nature and the book of Scripture, both written by God and 'readable' (but requiring interpretation). This metaphor depends crucially on God being the author of both books; a *theological* assumption that informs our science and reading of Scripture.

Figure 1. Is there a brick wall between science and Christianity, making them independent of each other?

What about natural theology? For McGrath, it does not prove God, but aims to show the rationality of the Christian worldview. We can argue from nature to God, or God to nature (which he seems to prefer). But we can also use it to critique other worldviews. McGrath uses scientism as a case study.

On the science-Scripture relationship, McGrath suggests the 'two books' approach, though it has limits, is the most fruitful way to deal with conflicts:

> "Any conflict between the actual facts revealed in nature (as opposed to extravagant scientific speculation about nature) and the biblical texts should lead the responsible exegete not to reject a scientific account of nature nor to doubt the truth of Scripture but to seek a better interpretation of Scripture in the light of these facts" (p. 97).

He highlights the approach of B.B. Warfield, who tried to harmonize Genesis with evolution, but said the Bible teaches God must have guided it.

On divine action, McGrath points out the problem we have talking about it is a peculiarly modern one. It arose after the success of Newton's 'mechanical philosophy' and the rise of deism. So, how do we reintroduce special divine action back into the conversation? Science is methodologically naturalistic, but *limited*. Other frameworks can be superimposed on the same events to give them a reasonable interpretation of special divine action. But then he appeals to Jesus' *death* to show this. An odd choice; we need to know what to do in cases like the origin of life and Jesus' resurrection.

He then applies this framework to the test case: the origin of humanity. Evolutionary science may explain a lot, but it does not explain everything. Moreover, reductionistic approaches seem ill-equipped to explain the rise of organizational structures (such as the human brain and the associated mind) that are more than the sum of their physical parts.

McGrath is a great 'tour guide' through the history of Western thought. He even picks out a few gems that can help the science-Scripture conversation along. However, for all his talk of the need to engage in the crucial and critical conversations, they are strangely absent. What do we do when science and Christianity make conflicting causal claims of the same reality? The dialogue fails if we fail to address the most important issues.

Interaction

Ruse's imagery of walking with McGrath effectively conveyed the commonalities and distinctions in their approaches. Gordon's response, however, seemed to go on a tangent. He noted the agreements and disagreements well enough, and even scored a few points on McGrath, especially on methodological naturalism. But most of his response went off on a tangent on the philosophy of time McGrath did not even address. McGrath was genteel in his response. He did note that much of the disagreement between him and Gordon may be more cultural than substantive; Oxford dons do things a little differently from American professors.

Bruce Gordon: constrained integration

Gordon's essay is not an essay *about* the integration of science and Christianity; it is a *proposal* for integrating the two (figure 3). And it is a conceptually dense *tour de force*. He weaves his way through many subjects with considerable verve and ingenuity.

First, the epistemic cornerstones of Gordon's approach are a principle of sufficient reason (every contingent state of affairs needs an explanation) and that our cognitive faculties cannot simply be blind nature at work, but must aim at producing true beliefs (when working properly). He argues that together the possibility of knowledge is grounded in God, and cannot be grounded in naturalism.

However, Gordon's philosophy of revelation has serious weaknesses. He notes that in the Bible God speaks through human authors, so we can distinguish between the intended meanings of God and the human authors. While true, it does not give us licence to say the two can conflict. However, this is precisely what he does in several cases, all to accommodate 'God's meaning' to deep time.

The most egregious example is Gordon's treatment of the Fall (pp. 142–143). He champions William Dembski's 'retroactive death' idea.[3] Basically, it says God imposed the effects of the Fall on creation *before* as well as after Adam sinned. However, this reverses the Bible's order—God making a "very good" world, and *then* God subjected the world to futility *in response* to Adam's sin (Genesis 3:17–19; Romans 5:12–21, 8:19–23). It also implies God never *actually* created a "very good" world. Moreover, it puts the punishment for the crime before the crime is committed. Furthermore, God *hides* the suffering-filled world from Adam until he sins *so that He can blame Adam for it*. This is deception of the worst kind. Anything but "very good" and 'God's intended meaning'.

More positively, Gordon attacks methodological naturalism as a constraint on scientific explanation. He points out its circularity; it assumes what is 'natural' to limit the study to what is 'natural'. This leads us nowhere. Instead, he invokes "uniformitarianism" as the basis for scientific explanation: "Modern uniformitarianism circumscribes scientific explanations by uniformly operating regularities or extrapolations from them" (p. 146).

But what about miracles?

> "In Christian perspective, some developments in the history of the universe might require extraordinary providence [miracles] for their proper explanation, while most may be explained by its ordinary course. Information is always generated from a reference class of possibilities, so which mode of providence prevails can be discerned from the informational properties of the phenomenon in question" (p. 147).

But notice the limit to discerning the mode of divine action: an examination of "the informational properties *of the phenomenon in question*". But does not Scripture also provide relevant data? After all, Scripture plausibly implies e.g. most of the rock record resulted from *non*-uniformitarian causes.[4]

Gordon also argues that quantum mechanics undermines any sort of necessitarian approach to the laws of nature. As such, the regularities of nature are irreducibly *contingent* features of reality needing an explanation. Naturalism cannot explain this, but God and His will can. However, Gordon then pushes this into an argument for a type of idealism, according

Figure 2. Are science and Christianity dialogue partners that bring together different perspectives on God's world?

to which there are no enduring mind-independent material substances. This is a controversial metaphysic, even among Christians.

Finally, using his 'uniformitarian' approach to science, Gordon says that we can detect some instances of intelligent agency, such as the origin of humans, the origin and development of life, and the origin and structure of the cosmos. There is much here that the biblical creationist can agree with. We can even agree that the strongest empirical cases for intelligent agency arise from these issues, and less so with e.g. the rock record. But this does not negate Scripture as data for reconstructing the history of nature, and creating a research apparatus on that basis.

Interaction

The interaction revealed quite clearly the differences between the views.

Ruse in his lively style did not pull punches. He did not like Gordon's whole project, since it is grounded on the *knowability* of God, which Ruse's apophatic/agnostic approach decries. McGrath, in contrast, was much more cordial and much closer to Gordon in content. McGrath is even quite open to a sort of 'metatheory of design'. He does, however, want to stop short of calling it *scientific* and maintain MN as a practical 'rule of thumb' for science. Gordon's rejoinder is largely an effective response. He points out the fundamental irrationalism in Ruse's Darwinian apophaticism. And he gives good reasons why McGrath should be more open to considering design explanations within a scientific context.

Editors: Christopher Reese and Paul Copan

The editors Christopher Reese and Paul Copan provide a preview (Reese) and post-mortem (Copan) of the interaction between Ruse, McGrath, and Gordon. They give the standard summation of the views, with Reese explaining the rationale for the book in the introduction, and Copan exploring some of the questions that arise out of the interaction in his post-mortem.

Some biases are evident, though, in these sections. For instance, since both are Christians, they are pretty clear that they both reject Ruse's independence view. Christianity is a historically falsifiable religion, based on miracle claims, and so it must appeal to historical evidence for miracles, which clearly forces a direct engagement with science. We cannot separate Christianity and science into two completely distinct realms. They also reject the conflict view (which is the fourth of Barbour's famous four categories) as inadequate both philosophically and historically, though it does tend to dominate the modern cultural consciousness.

Most interesting, though, was Reese's rationale for the book in distinguishing it from other multi-views books that address matters of science and Christianity.[5] Reese recounts his experiences moderating a Christian worldview forum, he found it necessary to ban discussion of certain science-related topics because of the heat they generated. So, he backtracks to make sure that we're all "In essentials, unity; in non-essentials, liberty; in all things, charity" (p. 11). As an example, he singles out the interpretation of Genesis 1 as a non-essential we should have liberty on, quoting the 'wise observations' of pastor/theologian Gavin Ortlund:

> "We can happily coexist within the church amid differences on this issue. Our unity in the gospel is not at stake. Instead, we should put more focus on the aspects of the doctrine of creation that Christians have classically emphasized and that are distinctive to a broadly Judeo-Christian worldview, such as creation ex nihilo, the historicity of the fall, and the fact that human beings are made in God's image. These are better hills to die on" (p. 11).

Is it surprising, then, that we do not find a young-earth creationist contribution to this volume? This is despite the fact that they are the only ones who really believe 'the historicity of the fall' in the sense of introducing death into the human world and to *nephesh chayyah*.

Figure 3. Do we need to integrate science and Christianity like a jigsaw to devise an optimally coherent worldview?

Assessment

The exchange was lively; it brings up many important questions for how science and Christianity relate, and the contributors offer many keen insights on the topic—especially Gordon and McGrath. For all this, the book is a worthwhile read.

However, is it a fair assessment of the spectrum of views on science and Christianity that actually exists within the church? Not by a long shot. A Bible-first approach was left out. Indeed, though both Gordon and McGrath are from Protestant traditions, there was no application of *sola*

scriptura to this question. Hermeneutical gymnastics were used to avoid the real potential for conflict between the Bible and the consensus of modern scientists. Even Ruse, a non-believer, was guilty of this!

After all, when we substantivize that *consensus* as 'science', we paper over the fact that it is a *human* discipline that can go wrong. Even *systematically* wrong. We forget that the assumptions which control the sciences that have the most direct bearing on Scripture—the historical sciences—may often be at odds with the assumptions we would use if we started from Scripture. And if we start from the wrong place, we're very likely to go to the wrong destination.

Instead, the contributors were allowed *carte blanche* to take pot shots at biblical creation that, frankly, were woefully misinformed. For instance, the one place in McGrath's contributions where his tone seems to rise above room temperature is in discussion of a biblical literalism that he clearly finds embarrassing:

> "What science does exclude is the idea, resting on a *highly questionable* biblical hermeneutic, that the world was created about six thousand years ago. This belief, which gained much support in England during the Elizabethan and Jacobean periods, rests on a *specific and deeply problematic* way of reading the Old Testament, making certain controlling assumptions that can now be seen to be wrong and that are not demanded or legitimated by the biblical texts themselves. This *spurious* dating of the origins of the world and humanity rests on a *flawed* interpretation of the Old Testament and is *not in any way* normative for Christians [emphases added]" (p. 56).

Compared to everything else McGrath wrote, this is positively vitriol! Nor is it even true. The chronological reading of Scripture that forms our 'controlling assumptions' has a long and venerable history in biblical interpretation that dates back to the church fathers.[6] Besides, he overestimates the need for 'chronological specificity' to demonstrate a conflict between the Bible and deep time. If Jesus put humanity's origins "at the beginning of creation" (Mark 10:6); if fossils conflict with a "very good" pre-Fall world (Genesis 1:31; cf. Romans 8:18–23)—then we have theologically crucial conflicts that do not depend on the sort of 'chronological specificity' McGrath aims at.

In a footnote, Gordon chided biblical creationists for our supposedly "arbitrary" application of "literalism" (p. 163). Apparently, we take the Genesis 1 days literally, but not the cosmography of Genesis 1. But cannot some parts be literal while others are figurative? And there are good reasons to take the timespan of Genesis 1 as literal history that do not exist for its depiction of cosmology.[7] This does not necessarily mean the cosmography is figurative,[8] but it shows that we do not hold to the literalness of aspects of Genesis 1–11 that conflict with deep time arbitrarily.

And it should surprise nobody familiar with Ruse that he has no time for creationists. He has spent much of his academic career fighting any hint of creationism from being taught in US public schools! Although, a while after these fights, he admitted that the creationists were right that evolution is a religion.[9]

The only other view that comes in for this sort of vitriol is the conflict view, for which they direct almost all their ire at one representative: Richard Dawkins. Only Ruse interacts with an actual philosopher who holds this view (Daniel Dennett), and when he does, he notes his disagreement, but does so more constructively than anything else. (Much earlier, Ruse wrote a blurb in his fellow contributor McGrath's book (with his wife) *The Dawkins Delusion? Atheist fundamentalism and the denial of the divine* (2010) saying: *"The God Delusion* makes me embarrassed to be an atheist, and the McGraths show why.") But at least the 'conflict' view is afforded the dignity of actual human faces to deconstruct! Biblical creationists are not even afforded that dignity. Effectively, we end up portrayed as the unnamed 'masses' too ignorant to warrant a personal mention.

Conclusion

Three Views on Christianity and Science is an incomplete book. What it covers is interesting and illuminating at many levels, but it fails to canvass the full spectrum of Christian thought on this question. Instead, it looks outside the church to dialogue. One is left to wonder: is there any room for biblical creation at the 'big questions' discussion table of science and Christianity?

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Novel compromising arguments in new theistic evolutionary book

The Liturgy of Creation
Michael LeFebvre
IVP Academic, Downers Grove, IL, 2019

Lita Cosner

There is a trend of theological books that conveniently show us how the Bible does not at all conflict with the modern scientific consensus. While not quite falling into the non-overlapping magisterial camp, they argue that the Bible's concerns are so different from those of modern science that the Bible's account has nothing to say about the scientific questions.

The Liturgy of Creation received a grant from the Templeton foundation, and that is all that needs to be said for one to predict the exact position the book will take on a whole host of issues including inerrancy, theistic evolution, and more. The author, Michael LeFebvre, is a pastor of a Reformed Presbyterian church and a professor at Reformed Presbyterian Theological Seminary.

A book on the Israelite calendar and its theological significance would be interesting to many theologically minded readers, but the author often transparently strains to make the text fit his preconceived narrative. For instance, he surveys ancient calendars, festivals, and deities, and says "the apostle Paul referred to such Gentile myths as 'seeking God'" (p. 13), which is the single most improbable use of Acts 17 one is likely to encounter in what purports to be scholarship.

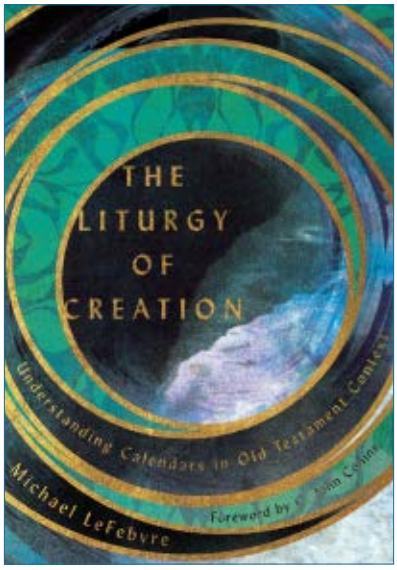
Occasional bizarre guesses with no basis in argumentation or any type of recognized precedent damage his credibility. For instance, he says:

> "It is conceivable that Israel also observed a lunar week. Most of the time this would be seven days long, and the ideal week would be regarded as having seven days (comparable to the ideal month having thirty days). But at least once a month, an eight-day week would be required. We know that Israel's solar year required periodic intercalation to stay aligned with the lunar months; perhaps the week, similarly, had a typical length of seven days but required occasional intercalation as well. Any society that follows the heavenly lights as its calendar will be accustomed to slight variations and the need for intercalations" (p. 27).

If LeFebvre can breezily dismiss as a "slight variation" adding an eighth day to approximately one week in four in a society structured around 6 days of work and 1 day of rest, without any support whatsoever, one wonders what else he simply asserts because it is convenient to his hypothesis! If he had done a survey of 'eighth day' in Scripture and extrabiblical calendrical texts and shown that there is a concept of 'eighth day' that is distinct from the 'first day' of the next week, that would have been a fairly straightforward way to substantiate his statement. If he wants to convince us benighted fundamentalists to embrace his view, he will have to try a little harder than that!

The Creation Week as calendar narrative

Part 3 of LeFebvre's book is dedicated to the Creation Week. He argues that "Genesis 1:1–2:3 provides a narration of creation events, but the timing and



details of its telling are transparently 're-mapped' to the cadence and themes of Israel's weekly sabbath festival" (p. 113). It would be a strange 'transparency' to not have been noticed by Jewish or Christian interpreters of Genesis over thousands of years until LeFebvre arrived on the scene to enlighten us all.

The Creation Week as a model for Israel and us

The elements of Creation Week as an example to us are things that creationists could mostly agree with. For instance, LeFebvre draws out the elements of stewardship, the pattern of work and rest, and other details that we would agree with. However, biblical creationists would see all this as built on the foundation of the history of what God actually did, while LeFebvre divorces these lessons from anything God actually did in history. This makes the points much less impactful than they are when we see Creation Week as the history which forms the model for our seven-day week.

The heresy of biblical errancy

It has become more common for theistic evolutionists to simply assert there are errors in the Bible, rather than try to redefine inerrancy to fit their

purposes. LeFebvre simply assumes there are errors in Scripture. For instance, he argues that Jesus simply "employed the popular perceptions of the day" in the parable of Lazarus and the rich man (p. 161), and that when Paul used the names Jannes and Jambres in 2 Timothy 3:8, the Holy Spirit "guided Paul to write within the cultural conventions of his day" (p. 162) without regard to accuracy.

This flippant attitude toward the accuracy of Scripture should be alarming to Christians who would otherwise be open to theistic evolutionary argumentation. Christians believe that our eternal future rests upon claims Scripture makes about the Person and work of Christ. There are good existing defences of both passages that are consistent with inerrancy, so why does LeFebvre feel the need to charge Scripture with error? And once Christians are able to say Scripture is in error, what keeps us from saying that the Holy Spirit was communicating a spiritual point with the virginal conception of Christ without concern for a historical event? What about the resurrection of Christ? And how does he *logically* draw a line between the events in Genesis and those in the Gospels?

Near the end of his book, he attempts to locate his views among the Church Fathers. He claims, "There is no single 'historical view' of the Creation Week events. In fact, the only facet of Genesis 1:1–2:3 that can be asserted as 'the historic position of the church' is its calendrical function" (p. 197). I get very interested in checking the sources when I hear the Church Fathers used to support unusual claims, so I fact-checked this chapter to show that he is either incompetent or a liar.

He says:

> "To quote John Calvin, 'This is a certain principle, that nothing here is treated of but the visible form of the world [i.e. how things appeared to the lay Israelite]. He who would learn astronomy, and other recondite arts, let him go elsewhere. Here the Spirit of God would teach all men without exception'" (p. 197).

Figure 1. LeFebvre mischaracterizes the beliefs of Church Fathers and Reformers like John Calvin to try to support his position.

Yet LeFebvre's bracketed insertion changes Calvin's meaning. From the context of Calvin's actual quote, it is clear that he is saying Moses is only talking about the physical reality of the world, not discussing philosophy. Moreover, on the *very next page* of Calvin's Genesis commentary, he asserts that plants were made before the sun and moon.[1]

He claims that Origen "reported that in his day [no one] doubts that these things figuratively indicate certain mysteries, the history having taken place in appearance, and not literally" (p. 198). Origen did take allegorical interpretation further than we would today; for instance, he believed that the six days of creation were allegorical, and it actually happened in an instant. But he also believed that Adam was the historical first man and that the earth was less than 10,000 years old, so his writing is not compatible with theistic evolution.[2]

LeFebvre cites a study by Letham concluding:

> "Luther is ... the first of the major exegetes that we have considered who without ambiguity adopts the interpretation that the days of creation are of twenty-four hour duration, at the same time arguing that the earth is only six thousand years old" (p. 198).

The reader may conclude from this that no one before 1500 believed in a 6-day creation 6,000 years ago, but what the reader *should* conclude is that Letham didn't do a very good study. Irenaeus said, around 200 years after Christ, that the earth was created in six days and thus would end after 6,000 years.[3] Bede (673–735) took Genesis to be a straightforward chronology of 1,656 years from Creation to the Flood, 292 years from Noah to Abraham, 942 years from Abraham to David, from David to the Babylonian exile 473 years, and from the Babylonian Exile to Christ 589 years. This gives 3,952 years from creation to Christ in Bede's view.[4]

Novel convenient compromise

The most fundamental argument against LeFebvre's argument is that no one in the history of theology in two major world religions ever interpreted the calendrical significance of the Creation and Flood events the way he did before him, and he does so in a context where his interpretation is quite convenient, to say the least. The only use for his interpretation is to let us know we can all stop dragging our knuckles on the ground and step into line with the new evolutionary orthodoxy.

LeFebvre ironically exhorts 'literalists': "In every era, God's people must resist the allure to prove God by reinterpreting his Word according to the philosophical ideals of the day" (p. 130). One would think this reproof would apply far more to theistic evolutionists who are the ones actually introducing novel readings of Scripture never seen in history.

Biblical creationists should be aware of developing theistic evolutionary arguments to be able to refute them. A basic awareness of church history and the interpretations of Church Fathers will become more important than ever as biblical creationists will need to defend the historical biblical creationist views of the Church Fathers and theologians throughout history.

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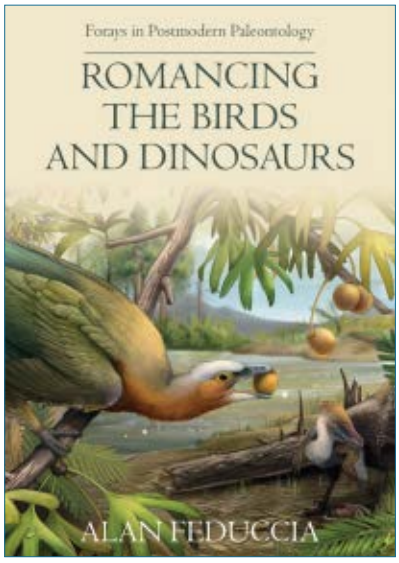
Alan Feduccia: the feathered dinosaur maverick

Romancing the Birds and Dinosaurs
Alan Feduccia
BrownWalker Press, 2020

Joel Tay



Romancing the Birds and Dinosaurs is the eighth book by fossil bird expert Alan Feduccia (figure 1). In this book, Feduccia provides a more systematic overview of how cladistics and a commitment to dino-to-bird evolution have turned contemporary dinosaur paleontology into a farce. Feduccia opposes the popular evolutionary consensus that birds are descendants of theropod dinosaurs. Instead, he believes that birds evolved further back in time from an archosaurian common ancestor.

Feduccia is a maverick. In this book, he takes on the evolutionary establishment and hones in on various aspects where he disagrees with the consensus. Each chapter focuses on a key aspect of this controversy.

Criticism of multivariate approaches in cladistics

Creationists skeptical of feathered dinosaur claims will find that Feduccia echoes many of the same concerns they have raised in recent years. For example, Feduccia criticizes multivariate approaches in cladistics that ignore or marginalize unique key traits. He points out that the move to eliminate character weighting in favour of hundreds of insignificant traits has resulted in the artificial grouping of unrelated creatures together. Since these analyses usually only involve bird and dinosaur measurements, the cladistic approach, by default, frames the narrative such that birds are more likely to be grouped as a type of dinosaur even if they are unrelated. This derived cladogram is then re-asserted as proof of dino-to-bird evolution despite the obvious circular reasoning.

Feduccia does not mince his words when it comes to attacking cladistics and how the methodology involves imposing ideology onto the evidence. A biological species is defined as a group of individuals that can breed together but are reproductively isolated from other groups. This is contrasted with phylogenetic cladistics which often results in the over-splitting of species.

Feduccia believes that the overarching paradigm that 'birds are living dinosaurs', together with a naïve application of cladistics, has resulted in several mistakes, namely: the belief that flight evolved from the ground up in both dinosaurs and pterosaurs (i.e. cursorial origin of flight); that aerodynamic flight feathers evolved as exaptations before the ability to fly; and that dinosaurs had to be warm-blooded since birds are warm-blooded. Feduccia believes that the unique anatomical and aerodynamic body plans of birds could not have evolved in a context other than flight.

Rejection of biomolecule finds in fossils

Feduccia rejects the possibility that scientists have discovered original biomaterial and DNA in dinosaur fossils. He acknowledges the fact that these biomolecules have such a short half-life that they cannot exist for millions of years old. Consistent with his belief in deep time, Feduccia dismisses all soft-tissue discoveries. However, at the time of writing, at least 115 publications spanning 29 journals have catalogued endogenous biological material in supposedly ancient bone.[1] 57 of these involve dinosaurs, and 7 of the papers are supposedly from samples that are dated to more than half a billion years using evolutionary dating assumptions!

I am unsure if Feduccia is aware of the number of publications that have discovered original biomaterials in 'ancient' fossils, but Feduccia is consistent here. Having recognized that biomolecules cannot last that long, and since he cannot reject the 'millions of years' as an evolutionist, he ends up concluding that all these discoveries are 'pseudo-science' (p. 33).

Two types of 'feathers'

Feduccia notes there are two types of 'feathers'. The first is 'proto feathers'. This group consists of filamentous fuzzy structures. These are not feathers, but decayed skin collagen. The second group consists of real pennaceous feathers on birds, but these birds have been wrongly classified as dinosaurs. Both 'feather' types are conflated into one so that birds are now regarded as theropods (p. 237).

Most evolutionists believe that dinosaurs evolved into modern birds. Therefore, it is easier to say that dinosaurs evolved endothermy just once early on in dinosaur evolution, rather than through convergence in each lineage leading to modern birds. Feduccia believes that dinosaurs were likely ectothermic and unrelated to the lineage that led to endothermic birds.

Cladistic circularity

While Feduccia is highly critical of cladistics, he is even more critical of phenetic approaches that do not discern between significant and insignificant traits. Cladistics today often involves algorithms that analyze hundreds of paleontological measurements. These measurements are then grouped according to how similar they are from one another. Feduccia calls these approaches 'clado-phenetics' (p. 138) somewhat similar to a more sophisticated form of 1970s phenetics.

Feduccia brings attention to the fact that there is an inherent circularity in cladistics. One problem is that of character weighting, where certain traits are given more significance than others. Quoting Peter Sneath, he points out:

> "One cannot reconstruct phylogeny from synapomorphies if one must first know the phylogeny to recognize correctly the synapomorphies. This is logically the same as trying to select the discriminatory characters before knowing which groups are to be discriminated. One must not know the answer in advance; to do so is not science" (p. 115).

However, Feduccia believes that there are even more problems for approaches that do not discriminate between significant and insignificant traits. Taking a non-discriminating approach is worse since it results in the marginalization of key traits. These approaches often give ambiguous results, and the genealogies that are obtained depend heavily on the data that is used.

For example, he cites crocodile-line archosaurs as generally only distinguishable from theropods and dinosaurs by the presence of certain key characteristics such as the ankle or hip structure. Feduccia believes that archosaurs, poposaurids, rauisuchians, and some putative saurischians evolved similar traits by convergence (p. 140). So *Postosuchus* was originally described as a theropod dinosaur, but later on, it was identified as a rauisuchian based on its key characteristic ankle. Feduccia uses this as an example of why the indiscriminate analysis of traits often results in unrelated creatures clustering together.

Feduccia claims that only 40% of published cladistic studies can be replicated (p. 116).

> "Most disturbingly, characters, typically skeletal, are represented in a binary code of ones and zeros, so that computer processing is facilitated according to a chosen algorithm. One can legitimately question whether the mind-boggling complexity of organisms can even be reasonably represented by such a simplistic and reductionist system. Massive numbers of unsorted characters, mostly primitive, have rendered such analyses meaningless" (p. 119).

Feduccia also refers to criticsms "by distinguished paleornithologist Gerald Mayr, who noted that the inclusion of huge, often trivial, characters produced a 'low ratio of phylogenetic signal to "noise" in the data'" (p. 124). Feduccia's criticism is important for the creationist community. It also applies to some creationist baraminology methods such as BDIST.

Vicariance biogeography

Vicariance biogeography is the idea that creatures gradually evolved after being isolated due to biogeographical events. For example, flightless bird populations may become isolated on an island due to continental drift. Traditionally, ratites are believed to have evolved this way from a single lineage of flightless birds. During the Mesozoic, ratites were stranded on continents during the Cretaceous. This resulted in rheas in South America, ostriches in Africa, and emus and cassowaries in Australia.

Image: JohannesPolonicus/CC BY-SA 4.0

Figure 1. Paleoornithologist Alan Feduccia in 2009. Feduccia is S.K. Heninger Distinguished Professor Emeritus at the University of North Carolina.

Interestingly, ratite fossils have yet to be found in Mesozoic layers. Feduccia points out that birds are morphologically very similar, and modern bird orders exhibit very little protein amino acid differences. This seems to rule out an ancient origin. But if ratites only evolved more recently in the post-Cretaceous era, how can continental drift during the Cretaceous have a bearing on the distribution of ratites? Feduccia believes that cladistics has been a failure in ratite phylogeny because these birds are secondarily flightless and paedomorphic, and cladistics is unable to take these factors into account. Unfortunately, the idea of a Gondwanaland origin of ratites has been used to calibrate molecular clocks for years resulting in false conclusions.

Feduccia criticizes Richard Dawkins who devoted 15 pages in *The Ancestor's Tale* explaining how ratites reached their present location by staying on dry ground. Contrary to this, Feduccia believes that ratites evolved from post-Cretaceous lithornithids or 'stone birds', and that recent genomic analysis supports the idea that these ratites independently lost the ability to fly after the K-Pg extinction event. Feduccia explains that molecular analysis shows that there have been at least six independent losses of flight in ratites after the breakup of the continents. He quotes Gerald Mayr, who concluded that the ratites continental drift explanation was "a textbook example of Gondwanan vicariance [having been] dismantled" (p. 160).

A few mutational changes in key developmental genes may often result in major phenotypic changes. Feduccia points to key characteristics that show that ratites came from flying ancestors. For example, despite losing the ability to fly, ostriches still retain the structure of flight-capable ancestors, cassowaries retain large rigid flight quills, rheas exhibit an alula and distinction

between primary and secondary feathers, and emus show a hallux that points backwards, which he regards as a sure sign of ancestors that perched in trees. However, many evolutionists ignore this and continue to insist that ratites evolved from non-flying ancestors. As with the flightless cormorant, organs may become vestigial through the loss of flight.

Creationists have long pointed out that whatever truly vestigial organs there might be are not problematic for the creation model. Secondarily flightless birds may retain real examples of vestigial organs associated with the loss of flight. This does not 'prove' evolution, since *vestigial* by definition is a breakdown and not gain of function.

Dollo's law

Dollo's law states that once a creature has lost a structure, it is unlikely that the same structure will evolve again in the same form in its descendants. While most paleontologists reject Dollo's law, most biologists see it as a significant principle for evolution. Reactivation of silenced genes and long unexpressed developmental pathways are not normally possible due to the statistical improbability of following the same evolutionary trajectory twice. While there are some instances where stick insects regain their wings, occasional exceptions do not disprove the general rule.

It is also important to note that Dollo's rule does not apply to variation within small local populations over short periods. For example, the beaks in Darwin's finches are labile and can reverse and adapt to conditions very quickly. But this does not negate Dollo's law. Dollo's law applies to creatures at the anatomical and molecular level over long periods.. For example, there are no examples of a secondarily flightless bird having re-elongated its wings and re-evolved flight again.

Feduccia applies this concept to dinosaurs. If Dollo's law were invalid, where are the examples of structures that are regained after an extensive loss, and why haven't snakes regrown limbs? (p. 183). Feduccia raises a question in light of Dollo's law: "is it possible for dinosaurs with already drastically reduced fore-shortened forelimbs to re-elongate these structures into elongated forelimb wings seen in the urvogel and basal birds?" (p. 185) Most evolutionists believe that theropods with foreshortened forelimbs evolved into modern birds with elongated modern wings. Feduccia says that this is highly improbable due to Dollo's law.

Digits in the hand of birds

Most vertebrates share a pentadactyl limb structure (homology). At a superficial level, theropods have a hand that resembles the birds. However, the embryonic development in both groups is very different. Therapods have elongated digits I, II, and III, but the corresponding digits in birds develop from digits II, III, and IV.

While cladistics today has a disdain for single key character analysis, 'trump characters' are logically more important than trivial bumps on bones (p. 190). However, dino-to-bird paleontologists reject this because this would require disavowing the cladogram. Most paleontologists ignore the evidence and insist that the avian hand has to be the same as those of dinosaurs. Feduccia calls this denial "establishing homology *a posteriori*" (p. 196). Most try to dismiss the problem by appealing to a homeotic frameshift during development. Feduccia likens appeal to a frameshift as a 'just so' story—a mysterious '*deus ex machina*' to save dino-to-bird cladistics.

Feduccia echoes what creationists have long said: vastly different creatures from fish, amphibians, birds, and mammals have similar-looking structures (homology), yet the genetics and the embryonic developmental pathways for these organs are very different. As an evolutionist, Feduccia admits that the classical basis of homology discerned by structure, position, and embryological connectivity is problematic, but that it remains the only reasonable and workable approach to homology today (p. 206). Creationists, on the other hand, have long pointed out that homology is best explained as evidence for a common designer. For example, while the pentadactyl structure is common among vertebrates, embryonic development,[2] and even the genes that control embryonic development are often different.[3]

Feduccia demonstrates that many birds are dated to be older than the supposed feathered theropods. Feduccia goes through many examples, and shows that phylogenetic models are often topsy-turvy.

Dino fuzz is not feathers

Focusing on the identification of dino fuzz, Feduccia points out that the downy covering on *Sinosauropteryx* does not represent feathers. The fibres are under the skin—within the confines of the body outlined on the fossil. He notes that small tuberculated dinosaurian scales were also observed on the body. He points to experiments and explains how the same fuzzy structure is found on fossils and carcasses of ichthyosaurs, dolphins, pterosaurs, and other creatures.

We have well-preserved impressions from hadrosaurs, sauropods, stegosaurs, ceratopsians, ankylosaurs, and theropods. Some are even preserved with details of internal organs and muscle. Feathers would have been preserved on those fossils if they had existed. Dinosaur skin is generally tuberculated, and only scales are observed wherever high-quality specimens are found. Feduccia cites two examples, a mosasaur fossil and a basilisk (*Basiliscus plumifrons*) where thick 'dino fuzz' lies beneath translucent scales—meaning that the 'dino fuzz' cannot be feathers but are just skin collagen (pp. 226, 245).

Birds did not evolve from dinosaurs

Feduccia believes that flight had evolved independently in some form

or fashion in 30 vertebrate lineages, yet no vertebrate has ever done so from the ground up. Feduccia then makes a case for an arboreal origin of flight in birds.

Feduccia takes several chapters to go through many of the alleged feathered dinosaurs and discuss their anatomy and whether they are birds or dinosaurs. Pennaraptors is a newly named group phylogenetically defined as the most recent common ancestor of *Oviraptor*, *Deinonychus*, and *Passer domesticus* (house sparrow). This is a group that includes the most avian of the maniraptorans. They include Oviraptorosauria, Dromaeosauridae, and Troodontidae—and possibly also the Scansoriopterygidae (figure 2).

Contrary to the popular view that birds evolved from dinosaurs, Feduccia discusses Gregory Paul's Neo-flightless Hypothesis. Gregory Paul considers maniraptorans to be either flightless or flying lineages of birds. Paul believes that some theropods were winged fliers, while others had flying ancestors but then lost the ability to fly and became secondarily flightless. Feduccia discusses the merits of Gregory Paul's approach. He acknowledges that some penneraptorans have some features common to birds, such as pennaceous flight feathers (not in all in this group), and a semilunate carpal. Thus, he agrees with Gregory Paul that they are derived from flying ancestors. Classic theropods lack this unique carpal feature.

Feduccia does not believe that dinosaurs evolved into birds, but that birds evolved from a separate lineage from an archosaurian line before the theropods. For this reason, Feduccia believes that penneraptorans are not theropods, nor are they related to dinosaurs. Feduccia concludes that *Deinonychus* is not a feathered dinosaur, but a secondarily flightless bird. Remember: in Feduccia's view, birds are not dinosaurs but are derived from a separate archosaurian lineage. Thus, it would be incorrect to call *Deinonychus* a dinosaur. The fossils from China that do show real pennaceous feathers, however, are from birds that have been wrongly classified as feathered dinosaurs. Feduccia is open to the possibility that *Velociraptor* may have feathers, although he thinks that the evidence for this is equivocal. However, even if it is shown that *Velociraptor* had feathers, like *Deinonychus*, it would not be a feathered dinosaur, but a secondarily flightless bird—again, remember that in Feduccia's view, birds are not derived from dinosaurs.

Feathered-dinosaur movement a religion

In the book, Feduccia often quips about how the dino-to-bird paradigm limits the way the evidence is interpreted, but the same criticism can be made about how his archosaur-origin paradigm shapes the way he interprets the evidence. This is a classic example of how scientific data doesn't speak for itself but is always interpreted in light of an *a priori* worldview.

Feduccia likens the feathered-dinosaur movement to a religion. Throughout the book, Feduccia describes proselytes of this movement with invectives such as dogmatic, orthodoxy, religious, faith, and cult-like.

He is equally hostile to both creationists and the Intelligent Design movement. He calls Intelligent Design a "supposed scientific term to disguise and substitute for special creation", calling it "a sleight of hand" that "provided their flocks with a sophisticated and refined system of 'belief', albeit not falsifiable, and therefore not science" (p. 37). However, apart from several passing remarks, the rest of the book sets its sights on those who believe that dinosaurs evolved into birds.

Conclusion

Despite the polemical undertone, this is a well-written book jam-packed with excellent technical analysis. It is chock-full of information, yet succinct, considering how much he manages to condense into 400 pages. The underlying thesis that runs throughout the book is that cladistics and a commitment to the dinosaur-to-bird paradigm have resulted in many false conclusions.

Creationists interested in the feathered dinosaur controversy will find this book to be rewarding. However, there is a need for the reader to be discerning and to give special attention to how his evolutionary presuppositions shape his interpretation of the evidence. The book is a nice follow-up to his 2012 book, *Riddle of the Feathered Dragons*, with a lot of new material. In *Romancing the Birds and Dinosaurs*, Feduccia ups the ante and makes a strong case for why dinosaurs could not have evolved into birds, although biblical creationists will also disagree with his archosaurian-origin model.

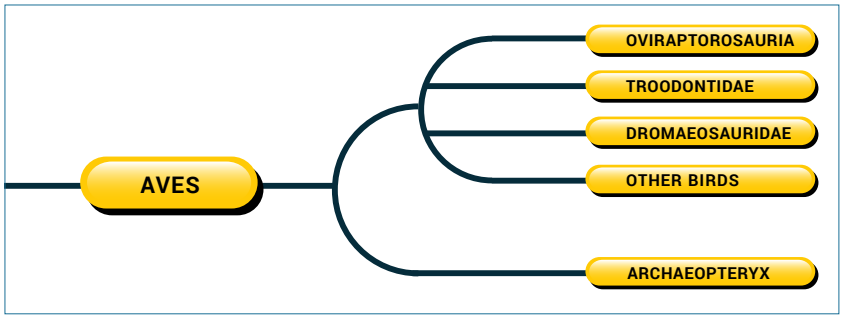


Figure 2. Feduccia's phylogenetic model where pennaraptors are considered to be birds (Aves)

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Horus—the deified Ham: part 1

Gavin Cox

One of the most famous and ancient of Egypt's many deities was Horus, the falcon sun-god. In two articles I explore 12 key motifs of the life of Ham (Noah's third son) drawn from the Genesis text. I then compare them to Horus drawn from Egyptian evidence, concentrating on the oldest evidence first. Part 1 looks at the following motifs: 1) Ham is 11th from Adam; 2) etymology of Ham's name; 3) Ham came from a family of eight; and 4) Ham, the youngest of three brothers. These comparisons support the thesis that Ham was deified by the pagan Egyptians as Horus.

Biblical historical foundations

Egypt is eponymously called "the land of Ham" (Noah's third son) in the Psalms (105:23, 27; 106:22) and "tents of Ham" (Psalm 78:51). Ham and Mizraim (Ham's third son) appear together in Psalm 105:23 as designations for Egypt:

> "… Israel came to Egypt (*miṣrā́yim*); Jacob sojourned in the land of Ham (*ḥām*)."

Here, 'Mizraim' is the common name for Egypt throughout Scripture. Ham was a first-hand witness of the Flood, and likely lived to a similar age as his brother Shem (500 years post-Flood, Genesis 11:11). Via Noah's teaching, Ham knew about creation and the pre-Flood world, knowledge he would naturally pass to his descendants. All this became paganized by the Egyptians. Ham's great post-Flood lifespan, involvement in re-establishing of post-Flood civilization, and knowledge of the pre-Flood world, likely meant he had divine status conferred upon him by the Egyptians.

Twelve key motifs of Ham's life

Twelve key motifs of Ham's life extracted from Genesis 5–11 (listed in table 1) will be compared to Horus. If Ham was deified as Horus, then the latter will likely reflect these motifs in some discernable, though paganized way. Article 1 will explore motifs 1–4, Article 2 motifs 5–12.

Both articles will set out to explore these connections, concentrating on the oldest Egyptian textual evidence in each case. Before this, a brief discussion of who Horus was is in order.

Introducing Horus—the falcon-solar deity

Horus is one of Egypt's oldest and most important deities, attested to from at least the beginning of the Dynastic Period, where the familiar form of the Horus falcon appears on the Narmer Palette (figure 1).

Horus appears in Old Kingdom Pyramid Texts (OK PTs), along with his sons, father, and mother (see part 2). Horus is depicted as a falcon (figure 2) or falcon-headed man, who was considered a creator god, as well as a form of the sun. His father was Osiris/Geb, with a notable brother, Seth. Myths associated with this family include the struggle between Horus and Seth after Osiris's murder (see part 2). Here, both brothers injure each other through violent struggle for dominion. Horus loses his eye, which itself becomes deified as the moon (Thoth), and his healthy eye as the sun (*Rēʿ*). Numerous aspects of Horus became separate deities—for instance 'Horus the child', 'Horus the elder', and Horus in his solar form. Pharaohs became the living embodiment of Horus, and received their 'Horus name'. Upon death they were believed to fly to heaven as the Horus falcon, to join *Rēʿ* in the solar barge, crossing the sky eternally.[1] Much could be written regarding Horus; however, my two articles will be limited to a discussion of Horus's possible connection to Ham, Noah's third son.

Motif 1. Eleventh from Adam: Ham cf. Horus

The Genesis 5:1–32 chronogenealogies place Ham (with his brothers) 11th from Adam.[2] Can a similar chronological relationship be discerned in Egyptian mythology, regarding Horus?

Egypt had a group of nine gods, called the Ennead, listed in OK PTs. Their sign was 9 flags, or vertical dashes, in Egyptian: *psḏ.t* (Wb 1, 558.12). They are listed in Pepis II PT-600§1655:

> "O Great Nine that is in Heliopolis—Atum, Shu, Tefnut, Geb, Nut, Osiris, Isis, Seth, Nephthys—Atum's children!"

"The Greater Ennead" *psḏ.t-ꜥꜣ.t* (Wb 1, 559.5) included Thoth, and Horus. When Osiris is accounted for, who appears as (father/brother) bystander, Horus's position appears 11th from Atum, Unas PT-219§167–177:

> "Atum ... Shu ... Tefnut ... Geb ... Nut ... [Osiris] ... Isis ... Seth ... Nephthys ... Thoth ... Horus."

In my previous article,[3] I made the case that Atum is the Egyptians' paganized memory of Adam. Here in PT-219§167–177, Horus is placed 11th within the Greater

Table 1. Twelve key motifs of Ham's life

#	Ham: biblical motif	Ham: Description	Genesis ref.
1	11th from Adam	Ham's genealogy places him 11th from Adam, who all lived to great ages	5:1–32
2	Name etymology	Name/character connected with concepts of (physical) 'violence', (earthy) 'blackness', (sun's) 'heat'	6:11; 8:22; 11:3
3	Family of eight	Four males and their wives	6:18; 7:7, 13
4	3 brothers, total	Ham (youngest), Shem, Japheth (eldest)	5:32; 6:10; 7:13 etc.
5	Father Noah	Noah (name means 'comfort/rest' from cursed earth)	5:29–32; 6:8–10 etc.
6	Ark (300x50x30 cubits; 3 decks)	Noah (and family) entered Ark (*tēḇaṯ*)/rested 17th of month	6:15–16; 7:11; 8:16–18
7	Flood	Flood global, sent in judgment	6:17
8	Noah's curse and blessings	Ham's sin [implied brotherly enmity], perversion [castration, emasculation, (rabbinic speculation)], debased political position	9:22, 24–27
9	Ham's four sons	Cush, Mizraim, Phut, Canaan	10:1
10	Journeyed from East to Shinar	After Babel YHWH scattered humankind, (including Ham and sons)	11:2, 8–9
11	"Land of Ham"	Ham, eponymously names Egypt	Psalms 105:23 etc.
12	Lived to great age	Ham likely lived to similar age as brother Shem	11:11

Ennead—taking into account Osiris as bystander—from the Egyptian Atum. This may represent a paganized memory of the genealogies of Genesis 5:1–32 where Ham (and brothers) stand 11th in-line from Adam. Although the Ennead was considered a unified group (typically of nine), evidence suggests (e.g. PT-600§1655), that they were simultaneously considered consecutive offspring of Atum.[4] However, what of the Greater Ennead's ages? Is there a comparison here with the lifespans of the Genesis 5:1–32 patriarchs?

Figure 1. Siltstone Narmer Palette (recto), CG14716 Narmer and Horus vanquishing foes

The 19th Dynasty Turin Canon papyrus (figure 3), though highly damaged, provides information regarding Egypt's earliest history, which designates Egypt's Predynastic rulers as *šms.w-ḥr.w* "Followers of Horus" (Wb 4, 486.16–19). Horus appears along with Seth and Thoth within columns 1 and 2 (fragments 11, 150) amongst the 'gods and demi-gods' with extraordinary reign lengths.[5] Interestingly, the first names in the list contain likely references to creation, as well as Horus, Seth, and Thoth[5] (known from the Greater Ennead).

Egyptologist K. Ryholt explains:

> "The mythological kings consists [sic.] of gods, demigods, and spirits. … The first name [*n ib* […]] could be brought into relation with the primaeval ocean, the time before land existed and water was everywhere. The name 'clod of the shore' [*pns.t n spṯ*] can hardly be other than a reference to the creation of life out of lifeless matter, earth. The two latter names ['possessor of noble women' (*ḫrḥm.wt-šps.w*[*t*]) and 'protector of [noble?] women' (*ḫw-ḥm.wt*-[*šps.wt*?])] could, perhaps, relate to the creation of women. Further below, in the

Figure 2. Horus statue in black granite, Temple of Horus, Edfu

Figure 3. 19th Dynasty Turin King List, in hieratic script

> now lost part of column 2, there was a further transition from demigods to spirits, which continues in the first nine lines of column 3. The spirits have generally been interpreted as prehistoric kings, but it remains unclear how much historical importance should be attached to the information the king-list has to offer."[6]

This sounds like a paganized reference to creation, Adam (from the earth), and Eve, up to later stages in the chronogenealogy, listed in Genesis 5:1–32. The nine lost lines may have included the number of mythical rulers described. That this papyrus seems to parallel Genesis from creation to the Flood was not lost on Eusebius, Bishop of Caesarea (AD 260/265–339/340), Roman historian, and exegete, who claimed access to material by Manetho (via the pseudepigraphical *Book of Sothis*). In W.G. Waddell's 1964 translation of the Armenian version of Eusebius, he purportedly states:

> "From the Egyptian History of Manetho, who composed his account in three books. These deal with the Gods, the Demigods, the Spirits of the Dead, and the mortal kings who ruled Egypt … [Eusebius lists these gods with Greek names, genealogically] … reckoned to have comprised in all 24,900 lunar years, which make 2206 solar years. Now, if you care to compare these figures with Hebrew chronology, you will find that they are in perfect harmony. Egypt is called Mestraim by the Hebrews; and Mestraim lived not long after the Flood. For after the Flood, Cham (or Ham), son of Noah, begat Aegyptus or Mestraim, who was the first to set out to establish himself in Egypt, at the time when the tribes began to disperse this way and that. Now the whole time from Adam to the Flood was, according to the Hebrews, 2242 years … ."[6]

Eusebius (relying on the extended LXX chronology) makes the unlikely claim the Egyptian chronology should be reckoned as months. Waddell in a footnote states:

> "(Fn. 1) The Pre-dynastic Period begins with a group of gods, consisting of the Great Ennead of Heliopolis in the form in which it was worshipped at Memphis … . In the Turin Papyrus the Gods are given in the same order: (Ptah), Rê, (Shu), Geb, Osiris, Sêth (200 years), Horus (300 years), Thoth (3126 years), Maᶜat, Har … ."[6]
>
> "(Fn. 5) 'Demigods' should be in apposition to 'Spirits of the Dead'… . These are perhaps the Shemsu Hor, the Followers or Worshippers of Horus, of the Turin Papyrus … ."[7]

Although Eusebius overstates the case, we perhaps have in the remains of the Turin Canon and the Greater Ennead the Egyptian version of the Genesis' chronogenealogies from Adam to Noah's family, preserved, though in pagan form, from the original memory of Ham, deified here as Horus.

Motif 2. Horus cf. Ham—name etymology: violence, blackness, heat

Etymology of Ham's name

As discussed in previous articles,[8] Ham's name can be understood via phonetic connections to similar-sounding words within the Hebrew text, biblical scholars call this 'paronomasia', (play-on-words, puns). At Genesis 6:11 the reason for the Flood is given—the earth is full of *ḥāmas* "violence, wrong" (HALOT-2980). A phonetic correspondence with 'Ham' is apparent in v. 11 (note orange-highlighted text):

Table 2. 'Ham' phonetically equivalent words, meanings, and earliest occurrences (phonetic roots highlighted orange)

Lexical ref.	Hebrew	Translit. (ḥ spelling)	Translation	Earliest biblical ref.
HALOT-2941	חָם	*ḥām*	"son of Noah"	Genesis 5:32; 6:10; 7:13 etc.
HALOT-2980	חָמַס	*ḥāmas*	"violence, wrong, cry for help"	Genesis 6:11, 13; 49:5
HALOT-2990	חֵמָר	*ḥēmā́r*	"bitumen, asphalt"	Genesis 11:3; 14:10; Exodus 2:3
HALOT-2993	חֹמֶר	*ḥṓmer*	"mortar, clay, ground material"	Genesis 11:3; Exodus 1:14
HALOT-7526	פֶּחָם	*peḥām*	"to blacken", "charcoal"	Proverbs 26:1; Isaiah 44:12
BDB-2905	חוּם	*ḥûm*	"darkened, dark brown, black"	Genesis 30:32, 33, 35, 40
HALOT-2988	חמר	*ḥmr*	"to scorch, or burn", "reddish brown"	Job 16:16
HALOT-2940/2	חֹם	*ḥōm*	"hot, warmth, heat"	Genesis 8:22; 18:1; Job 6:17
(no ref.)	אֶרֶץ־חָם	*ʾereṣ-ḥām*	"Land of Ham (Egypt)"	Psalms 105:23, 27; 106:22
		Translit. (k spelling)		
HALOT-4299	כמר	*k̲imr*	"darkening"	Job 3:5
HALOT-4295	כמר	*k̲m*	"Hot, burning, excited"	Genesis 43:30

וַיּוֹלֶד נֹחַ שְׁלֹשָׁה בָנִים אֶת־שֵׁם אֶת־חָם וְאֶת־יָפֶת: 6:10
וַתִּשָּׁחֵת הָאָרֶץ לִפְנֵי הָאֱלֹהִים וַתִּמָּלֵא הָאָרֶץ חָמָס: 6:11

"And Noah begat three sons, Shem, Ham (*ḥām*), and Japheth. Now the earth was corrupt in God's sight, and the earth was filled with violence (*ḥāmās*)" (Genesis 6:10–11).

Theologian Moshe Garsiel states of the pun that it: "… does not serve here merely as sound play but implies a connection between Ham and 'lawlessness'. Later on (9:22–27), this son indeed displays the inferiority of his nature compared to his brothers."[9]

The word *ḥāmās* occurs three times in Genesis (6:11, 13; 49:5). The meaning of this word becomes apparent at Genesis 49:5, within Jacob's curse and blessings of his sons. The verse in question states: "Simeon and Levi are brothers—their swords are weapons of *ḥāmās*." The context demands 'violence', not merely moral wrongdoing. It is this specific aspect of *ḥāmās* that lead to the Flood judgment.

Two more phonetic connections to 'Ham' can be discerned after the Flood:

1. YHWH makes a covenant with Noah and his family, promising dependable seasons (Genesis 8:22) cold and "heat" (*ḥōm*).

עֹד כָּל־יְמֵי הָאָרֶץ זֶרַע וְקָצִיר וְקֹר וָחֹם וְקַיִץ וָחֹרֶף וְיוֹם וָלָיְלָה לֹא יִשְׁבֹּתוּ: 8:22

"While the earth remains, seedtime and harvest, cold and heat (*ḥōm*), summer and winter, day and night, shall not cease."

2. Ham's grandson Nimrod (Genesis 10:8–10) at the construction of the tower of Babel provoked the next judgment of humankind. Cassuto noticed a play-on-words in Genesis 11:3,[10] specifically in its construction materials:

…וְהַחֵמָר הָיָה לָהֶם לַחֹמֶר: 11:3
…wəhaḥēmā́r hāyāʰ lāhem laḥṓmer.
"… and the bitumen hath been to them for mortar" (Genesis 11:3, YLT).

The Babel rebellion was actualized through building, including with *ḥēmā́r* for *ḥṓmer,* bitumen for mortar—specifically—black/dark coloured earthen materials. This word, *ḥēmā́r*, occurs three more times in the Old Testament. Next is Genesis 14:10, where the kings of Sodom and Gomorrah fell into 'tar pits', and lastly in Exodus 2:3, where in Egypt, the infant Moses' basket was waterproofed with 'tar'. Next, *ḥṓmer* occurs in Exodus 1:14, when Israel laboured with 'mortar' for the Egyptians.

These similar 'vocables' (*ḥāmas, ḥōm, ḥēmā́r, ḥṓmer*) phonetically connect to Ham. A theoretical semantic range for Ham's name can be established when comparing similar-sounding Hebrew words in the early chapters of Genesis.[11] Table 2 lists these earliest occurrences of phonetically connecting Hebrew words and their meaning, thereby offering vocabulary and semantic range by which the name 'Ham' can be understood.

From the evidence presented in table 2, Hebrew words found in Genesis (and the ancient book of Job) encapsulate three key concepts connecting phonetically to Ham's name: 1) (physical) 'violence'; 2) (earthen) 'blackness/darkness'; and 3) (sun's) 'heat', whereby etymologically, Ham's name is understood. Are these three concepts integral to Horus? The following evidence (A–C) suggests this is so.

Phonetic considerations for Ham's name in relation to Hebrew and Egyptian

Hebrew *ḥām*, is pronounced with an initial voiceless pharyngeal fricative <ḥ>, middle aleph <a> vowel, and terminal, nasal bilabial <m>.[11] Furthermore, <ḥ> is grouped with the guttural fricatives: <ḫ>, <ḥ>.[12] Phonetically similar 'voiceless stops' /k/ and /kh/ (excluding ḳ) coexisted in Egyptian, and survived into Coptic—for instance ⲕⲏⲙⲉ and ⲭⲏⲙⲓ represent two forms of *km.t* ('Egypt') (see section B).[13]

Through evidence of Semitic loan words into Egyptian[14] Hebrew ḥeth (ח) is consistently transcribed into Egyptian as /ḥ/. Hebrew kaph כ is transcribed into Egyptian as /k/ or /g/, never /ḥ/. Words containing the biliteral symbol *km* 𓆎 (as in *km.t*) provide no examples of Semitic exchange. Therefore, from established phonetic evidence it cannot be proven that Hebrew *Ḥam* and Egyptian *km* are related names, despite their superficial phonetic similarities. However, two examples of Hebrew words, meaning 'black' (Job 3:5, hapax legomenon) and 'hot' (Genesis 43:30, three occurrences) are spelled with Hebrew <k>, offering a possible phonetic relationship, which requires further research.

A) Violent Horus—the attacker-spirit (kk)

The following textual evidence associates Horus with struggle, violence, and war. For instance, the divine epithet *tkk*, means "attacker, to attack" (Wb 5, 336.2–11). The significance of the root *kk* will be discussed in motif-3. This is found in OK PT:

> Teti PT-292§433a.
> *ntk tkk.n tk.j jkn-hj*
> "You're one the attacker attacked, *jkn-hj*-Snake!"

The one attacking is explained and the epithet applied to Horus in a Middle Kingdom Coffin Text (MK CT): CT-885.

> *jntk tkk ntk ḥr.w nn.w sp-2 ḏ.t r p.t*
> "You are the attacker, you, Horus! Sink down wearily, Cobra, from heaven!"

The Egyptian Book of the Dead (BOD) glorifies the violence of Horus, for example chapter 19 (22nd Dynasty) states:

> "Osiris N. has repeated praise 4 times, for all his enemies are fallen, overthrown and slain. Horus the son of Isis and the son of Osiris has repeated millions of jubilees, for all his enemies are fallen, overthrown and slain. They have been carried off to the place of execution, the slaughtering-block of the easterners. They have been decapitated, they have been strangled, their arm(s) have been cut off, their heart(s) have been removed. They have been given (to the Great) Annihilator in the valley; they shall never escape … ."[15]

Egyptologists A.M. Blackman and H.W. Fairman recognize Horus as the god of war, who may have had a kernel of historical reality as a founder of Egypt:

> "Junker has expressed the opinion, not without reason, that the god of Edfu, Horus of Behdet, was in his original form a warrior-god as well as a divine king, the stories of whose exploits rest ultimately on an historical basis. That basis, if we accept the theory propounded by Sethe in his Urgeschichte [prehistory], is to be found in the wars waged in pre-dynastic times by the Horus-kings of Heliopolis, whose frontier town was Edfu, against the Seth-kings of Ombos and southern Egypt."[16]

B) Ham cf. Horus: (Earthy) blackness/darkness

An important word for 'black' in Egyptian is *km* (Wb 5, 124.10–12), and Egypt's name *km.t* means "the black land" which refers to the black fertile Nile-flood soils (see part 2). From the discussion above, Egyptian '*km*' and Hebrew '*Ḥam*' share semantic concepts of 'earthy blackness/darkness'. Here we have an immediately apparent link with the black earthiness inherent in Ham and Egypt's names.

Horus the 'very black'

Egyptologist T.G. Allen stated that "Horus is black and great (or 'very black') in his name of *km-wr.*"[17] For instance:

Figure 4. Apis bull (black serpentine) bearing solar disk, 400–100 BC, Cleveland Museum of Art

PT-600§1657a–1658d.
(§1657a) *ḥr.w* … (§1658a) *km.t wr.t m rn=k n(.j) ḥw.t-km-wr* … (§1658d) *ḥr.w*
"Horus … .You are black and great/ very black in your name 'House of the Great Black [Bull]'… Horus … ."

The French Egyptologist Émile Chassinat recognizes *km-wr* signifies Horus from a "very early stage" [18] and that the black bull of Athribis was worshipped as the incarnation of Horus.[19] For instance, an inscription engraved on the sarcophagus of the Apis bull, which died in the year 2 of Khabash (31st Dynasty pharaoh) is said to be: "Loved by Apis-Osiris and Horus the black bull."[18] Chassinat states: "The quality of 'great black bull' attributed in our ritual to the local Osiris, associates him with Horus in his bovine incarnation"[20] (figure 4).

Horus is also described as dwelling in "darkness" (*kk*), for instance:

(18th Dyn.) pKairo G51189 (pJuja), Tb153.
ḥr.w {tw} pw ḥmsi(.w) wꜥi.yw m kk.w jw.tj mꜣꜣ=f
"That is Horus, sitting alone in the darkness, who cannot be seen…"

I will return to the significance of Horus epithets containing the root *kk* (in motif 3).

C) Sun's heat: Horus cf. Ham

Genesis 8:22 "covenant of the seasons" uses '*ḥōm*' to describe heat from the sun (thereby expanding the semantic range of Ham's name to include concepts of the sun's 'heat'). Horus is fundamentally connected to the sun and heat, being worshipped from the earliest times as the solar deity Rēꜥ-Ḥarakhti, (*raw-ḥr.w-ꜣḫ.tj*)—a triple-epithet combining Rēꜥ the 'sun-god', with 'Horus', who is 'dwelling in the horizon'.

Egyptologist T.G. Allen states:

"The eye of Horus was further identified with the sun … Pyr. 698, either an instance of identification of Re and Horus or a further case of the eye assuming the place originally belonging to Horus himself."[21]

For instance Pepis II PT-402§698d states:
(|*ppy*|)(|*nfr-kꜣ-rꜥw*|) *pw jr.t tw n.t* {*ḥr.w*} <*raw*> *sḏr.t jj.t msi.t raw-nb*.
"Pepi Neferkare is that Eye of {Horus} <Re> who is conceived and born at night, every day."

Egyptologist S. Edwards points out that pyramid "T[eti] has the Eye of Re and N[eith] has the Eye of Horus"[22] indicating Horus and Re were thought of as synonymous.

The flame and heat of Horus's eye is particularly spelled out in MK CTs. For instance, CT-313:91:

"I am Horus, son of Osiris, born of the divine Isis. I am king in Chemmis, my face is formed as that of a divine falcon; I created my Eye in flame … ."[23]

Egyptologist R.L. Shonkwiler recognizes Horus's connection by birth to the heat and flame of the sun, stating: "As the 'solar child', Horus is born in the Island of Fire after being conceived by flame."[24]

A further epithet of Horus appears in OK PTs connecting him with "fiery breath" (Wb 1, 471.16) *bḫḫ.w*, for instance:

Unas PT-313§503a–503b.
... ḥr.w sp 2 sbn (|*wnjs*|) [*j*]*m m bḫḫ.w pn ḫr jkn.t nṯr jri=śn wꜣ.t n* (|*wnjś*|) *śwꜣ* (|*wnjś*|) *jm=ś* (|*wnjś*|) *pj ḥr.w*

"... Horus (twice) ... Unas there in that glow of fire, under ... the gods.
They pave a way for Unas so that Unas may pass on it.
Unas is (a) Horus."

Furthermore, the phonetic root of 'fiery glow' *bḫḫ.w* (*ḫḫ*) is shared with an OK divine name *jḫḫ.w* "twilight" (Wb 1, 126.5) e.g. Teti PT-421§751b, demonstrating a phonetic link with *kk* root words (see motif 3).

Motif 2 summary

Like biblical Ham, Horus is synonymous with concepts of: A) (physical) "violence" (*tkk*); B) (earthy) "blackness" (*km*)/"darkness" (*kk*)/"twilight" *jḫḫ.w*; and C) (sun's) "heat" (*bḫḫ.w*). The significance of the root *kk* is discussed in motif 3.

Motif 3. Family of eight—Horus cf. Ham

Genesis (6:18, etc.) informs us that Ham belonged to a family of eight—comprising four males and their wives.

Ancient Egypt had a group of eight gods—comprising of four males and their wives (the Ogdoad) whose names (see later) appear in OK PTs. In previous articles,[25] I concluded this group represented the paganized memory of Noah's family. The question to be asked is, if Horus is the deified Ham, is he also connected to a family of eight? Evidence presented below suggests he was. Specifically, the Ogdoad, whose names include the couple Kek and Keket (*kk* and *kk.t*).[11]

Like the semantic meaning of Ham, as discussed above, Horus is also connected by similar concepts: "attacker" (*tkk*), "darkness/twilight" (*kk, jḥḥ.w*) and phonetically similar *bḥḥ.w* "heat". Ogdoad *kk* can be understood semantically from words containing the phonetic root *kk*, (compare *ḥḥ*). Thus, a shared semantic range exists between biblical Ham, Horus, and Ogdoad couple *kk(.t)*.

Additional textual and pictorial evidence connecting Horus to the Ogdoad comes from the BOD (figures 5–7).

Egyptologist E.A.W. Budge explains the context of Hunefer's vignette from BOD chapter 17 (figure 5):

> "The sunrise. Beneath the vaulted heaven stands a hawk [Horus], having upon his head a disk encircled by a serpent, emblematic of the sun-god … . Ra-Harmachis (*sic*). On one side are three and on the other four apes, typifying the spirits of the dawn, who are changed into apes as soon as the sun has risen. The accompanying legends read: 'Adoration to Ra when he riseth in the horizon. Adore thee the apes, Oh Ra-Harmachis'."[26]

Further evidence comes from BOD (figure 6) which places Horus amongst the Ogdoad.

Egyptologist E.A.W. Budge gives the context of this vignette:

> "… The mummy of Anhai (*sic*) lying on the top of the double staircase, which is in the city of Khemennu [Ogdoad city] … . Above are eight white disks [representing Khemennu/Ogdoad] on an azure ground … . The god Nu raising the boat which contains the beetle and Solar disk, and seven gods … ."[27]

One question to be asked here is the shape of the solar bark—it is not like that of Noah's Ark—if indeed it represents it. The divine boat has a flat keel, distinctively high, curved prow, stern, and fixed rear oars. This specific shape will be discussed in part 2 (motif 10), and its dimensions (motif 6).

The eight gods and Horus

The 'spirits of the dawn' were typically eight baboons heralding the first sunrise—representing the Ogdoad. This is demonstrated beyond doubt from tomb wall inscription at the 26th Dynasty tomb of Ba-n-nentiu, Bahria Oasis. The image below (figure 7, lower register) shows the Ogdoad in simian form, worshipping Horus as the sun (in the top register), sailing the solar barge across the sky, attended by various deities.

Figure 5. Vignette from Hunefer BOD, chapter 17, EA9901-8, c.1292–1190 BC, 19th Dynasty (from Budge[26])

Figure 6. EA10470, Papyrus of Ani. Nu holds the solar bark containing Horus (back, left) and six other anthropomorphic deities, possibly representing (in total) the Ogdoad. (from Budge[26]).

The cartouches written above the Ogdoad read (from right to left): Nu, Nunet, Amun, Amunet, Hehet, Heh, Keket, Kek. The Ogdoad is also symbolized with a single baboon determinative,[29] seen from evidence from the Great Hymn to Amun at Hibis temple. Egyptologist David Klozt explains:

> "The baboons at Hibis address the newborn sun in epithets similar to those used in the Book of the Day, which is also present in the Solar Chapel of Medinet Habu. At the same time, the horizontal texts above the baboons are actually excerpts from the Great Amun hymn, an indication that these eight baboons are simultaneously understood as the Ogdoad. The Ogdoad are associated with Amun elsewhere only in the Small Temple of Medinet Habu, and their striking presence at Hibis suggests some relation between the theology of Medinet Habu and Hibis … ."
>
> [footnote 68] "the column 0 of the Great Amun hymn … write 'the Ogdoad' with a baboon [𓃠 determinative]."[30]

Figure 7. Ogdoad as baboons (lower register) assist Shu supporting the sky (from Fakhry[28])

The worshipping baboon determinative, in the BOD Hunefer vignette (figure 5) is accompanied by the hieroglyph *htt*, "Screamer" (Wb 2, 504.4-6) indicating the Ogdoad (). However, only seven baboons worship Horus Ra-Harakhty. It seems one of the Ogdoad members has become Horus. A passage from the CT supports this theory:

CT-50:223–225

"The Followers have given hands to the Chaos-gods, Horus the Protector of his father is glad … . Horus, pre-eminent in Khem … to you there belongs one of the two Chaos-gods … ."[31]

I demonstrated previously that the Eight Chaos-gods are to be connected with the Ogdoad.[32] The Chaos-gods came in pairs, here, one of the pair of Chaos-gods is described as "belonging to Horus", which could well be *kk*—who represents primeval darkness. That being the case, *kk*'s ascent to the sun follows the natural course of dusk to dawn.

Motif 3 summary

As Ham came from Noah's family of eight, Horus also comes from a group of eight gods.

Motif 4. Ham cf. Horus—three brothers

Scripture states Noah had three sons: Ham "his youngest" (Genesis 9:24) and "Shem … brother of Japheth the elder" (Genesis 10:21 YLT). Here Scripture employs the adjective קָטָן (*qāṭān*) HALLOT-8338 'small, youngest' to describe Ham. Can similar relationships be discerned in Horus's family? The following evidence suggests this is so.

Horus is described in Pepis I PT-539§1320c as:

Ḥr.w nḫn(.w) ḫrd
"Horus, the little child."

Horus had a notable brother called Seth, with whom he violently struggled (see motif 8), for instance:

Merenre PT-615§1742a.
jmi.y jr(.t)-ḥr.w ḥr ḏnḥ n.j sn=f stš
"Put the eye of Horus on his brother Seth's wing."

Also Pepis I-667a§1948b:

"[Horus will] be cleansed of what [his] brother [Seth] did to him, [Seth will be cleansed of what his brother Horus] [did] to him … Horus will be purified when he [embraces] his father] Osiris."

Another god, called Thoth is constantly associated with Horus and Seth in PTs, indeed, there is a clear overlap between Seth and Thoth as noted by Čermák,[33] who also recognizes family relationships are often contradictory. Seth is brother to Horus, and yet simultaneously brother of Osiris in PT. However, Seth and Thoth are described as brothers together in:

Neith PT-218§163d.
m=k jri.t.n stš ḫna ḏḥw.tj sn
"See what Seth and Thoth have done, your brothers" (referencing Pharaoh Neith).

Neith PT-370–375.
ḫai.t (*j*) *m bj.t* (*j*) *ḥr.w ḏḥw.tj snsn.w jr=k m sn bj.t* (*j*) {*ḥr.w*} {*ḏḥw.tj*}
"You appeared as King of Lower Egypt and Horus and Thoth have joined you as the two brothers of the King of Lower Egypt" (referencing Pharaoh Neith).

The following (MK) Coffin Text makes clear the brotherhood of Horus, Seth, and Thoth: CT-681.

"O Thoth, son of the Harpooner, brother of Horus and Seth, who are on your throne, silence Seth."
(Faulkner 2004: II, 246).[34]

Čermák recognizes the role of Thoth in that the mythical fight between the two brothers Horus and Seth that he "pacifies the two fighters Horus and Seth, bringing to an end the archetype of discord in the world"[35] (see motif 8).

And in the BOD, a TIP papyrus of Pennesuttawy (Egyptian Museum JE95881) makes Osiris the father of Thoth:

"Words spoken by Thoth, lord of the words of the god, writer of what is right for the Great Nine Gods, before his father Osiris lord of eternity [*wsir nb ḥḥ*]."[36]

Motif 4 summary

Horus had a brother, Seth, (both sons of Osiris) with whom he struggled violently for political dominion (see part 2, motif 8). A closely aligned god called Thoth is described as a brother of either Seth, or Horus in the PTs, and one example in the Coffin Texts of Horus, Seth, and Thoth being described as brothers. In BOD, Thoth shares the same father (Osiris) as Horus and Seth. When these examples are considered, then Horus is comparable to Ham in having two other brothers, and himself being described as the 'youngest'.

Conclusion

This article has looked at four motifs from Ham's life and compared them to Horus, the Egyptian falcon sun-deity. We have found positive connections in the following areas: motif 1. Ham was 11th from Adam. The case can be made that Horus is 11th from Atum when Osiris as the fatherly bystander is included from evidence in PTs regarding the Great Ennead. Motif 2. The etymology of Ham's name includes concepts of (physical) "violence", (earthy) "blackness/darkness", and (sun's) "heat". These concepts compare favourably with divine epithets of Horus. Motif 3. Ham came from a family of 8—four males and their wives. The case is made here that Horus ascended from the Ogdoad, who are four males and their wives. Specifically, Horus is connected to Ogdoad member *kk* (darkness) in which case *kk* follows the natural ascension of darkness to light, to transform into Horus as the sun. Motif 4. Ham was the youngest of three brothers, Shem, and Japheth. The case can be made that Horus is the "child" who has a notable brother, Seth, and closely aligned to Thoth, another brother-(like) god. The connections are intriguing and so merit further study. Part 2 will analyze motifs 5–12.

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Dread of man: part 1—hermeneutics, cultural evolution, and biblical history

Philip B. Bell

Traditionally, God's words about the fear and dread of mankind (Genesis 9:2) have been seen as descriptive of the post-diluvian world rather than prescriptive. However, the eating of all kinds of animals was sanctioned immediately afterwards (Genesis 9:3). I advance the thesis that both statements are closely connected, that the 'dread of man' actually represented a second major biological juncture in history, akin to, though less obvious than, the corruption of animals arising from the Curse. In other words, God supernaturally altered animal psychology when lifting the bar against humans eating meat (Genesis 1:28). Part 1 of this paper begins to explore this proposal, including an overview of the thoughts of previous Bible commentators on these verses. Anticipated objections are explored and answered comprehensively. Part 2 explores the ramifications in much more detail.

In this and a succeeding article we will consider the importance of God's words to the eight survivors of the worldwide Flood, shortly after they had come out of the Ark (Genesis 8:16):

> "The *fear of you and the dread of you* shall be upon every beast of the earth and upon every bird of the heavens, upon everything that creeps on the ground and all the fish of the sea. Into your hand they are delivered. Every moving thing that lives shall be food for you. And as I gave you the green plants, I give you everything [emphasis added]" (Genesis 9:2–3).

I will propose that the full significance of these verses has been missed by Bible commentators and biblical creationists. The 'dread of man' likely represents a supernatural intervention which forever altered animal psychology. These instructions were given to Noah and his family, and by extension, to all human beings. They have fascinating implications for aspects of ethology but especially for human history. God's decree made a substantial difference to the post-Flood behaviour of terrestrial and marine creatures. It is also crucial for a full appreciation of the origin of hunting, and more besides.

In part 1 of this study, we will first briefly review the perspectives of some important evangelical commentators on Genesis, including those with a commitment to biblical creationism. This will fall short of a comprehensive treatment of the subject, as requiring a dedicated paper in itself.

Next, we will contrast biblical and secular anthropology regarding the procurement of food. Historical records indicate that the ancients were agriculturalists. Nevertheless, long-entrenched evolutionary anthropology avers that farming is a late invention, antedated by a hunter-gatherer subsistence for hundreds of thousands of years. On the other hand, a plain reading of Genesis depicts the Edenic state as one of perfect harmony between people and animals, and a vegetarian diet for all of them. The centuries of corruption following the Fall and Curse drastically altered that, eventually culminating in the Flood judgement of rebellious mankind.

We will also review how Genesis describes the antediluvian world as filled with violence and murder. The fossil record confirms that this included animal violence and carnivory. Moreover, some people brought animal sacrifices to God, yet the Bible is silent as to the consumption of meat by human beings during that period. Not until Noah's family leave the Ark does God specifically sanction the eating of animals, while simultaneously informing them that every kind of creature would thereafter fear and dread human beings (Genesis 9:2). I will argue that this speaks of a biological juncture. God's radical intervention changed animal psychology (thus aspects of animal neurobiology) from that point onwards.

Some readers may be suspicious of what they deem a novel, even gratuitous, interpretation of Scripture. Therefore, we will conclude part 1 of this study by answering objections, real or anticipated. Can this thesis be maintained in light of various biblical and scientific considerations?

In the following paper, the implications of this thesis will be opened up in more detail. What is the biological basis for fear? How did the Noahic family fare immediately after leaving the Ark, in terms of procuring food? What of the violence of the pre-Flood (Genesis 6:11) and post-Flood periods? We will consider the advent of hunting, the significance of Nimrod (Genesis 10), dietary issues, even the advent of gardening. Seeing Genesis 9:2 as a divine intervention biologically has a number of interesting implications. It also further highlights the incompatibility of Scripture with the prevailing evolutionary worldview.

Image: Annika Thierfield © Pexels.com

Figure 1. Animals today generally fear human beings. Was God's instruction in Genesis 9:2 concerned with protecting post-Flood people from attack and predation by animals, or to shield animals from the excesses of people?

Expository thoughts by Bible scholars

In reviewing many evangelical commentaries, I was unable to find any that approached Genesis 9:2–3 in line with the thesis put forward here. The Hebrew words 'fear' and 'dread' convey the idea of animals being in terror of human beings, but why would this be (see figure 1)?[1] Some have seen this merely as a restatement of mankind's dominion over the creatures, which had been frustrated by the Fall. Basil Atkinson (1895–1971) was of this view, onetime Under-Librarian and Keeper of Manuscripts at Cambridge (UK). He (over)spiritualized the 'dread of man' and had nothing to say about the actual post-Flood world:

> "In the spiritual sphere, the child of God, armed with the Gospel, is given dominion over every beast, the savage governments and fierce intolerant individuals in the world, over *every fowl*, all the opponents of the Gospel, over *all that moveth upon the earth*, earth-born men of worldly interests, *and upon all the fishes*, creatures not affected by the flood, those standing outside the stream of revelation in ignorance of the covenants, the teeming millions of heathen, spread over the world [emphases in original]."[2]

Entirely bypassing the historical nature of God's words, he instead equated this 'renewal' of man's dominion with "the preaching of the Word and the proclamation of the Gospel".[2] Similarly, contemporary British Old Testament scholar and evangelical commentator Gordon Wenham (1943–) believes God was not speaking of the post-Flood situation at all. He writes that Genesis 9:2 "seems more likely to reflect the animosity between man and the animal world that followed the fall … ."[3]

However, most commentators acknowledge that Genesis 9:2–3 looks forward. American Professor of Old Testament John Currid (1951–) writes, "now mankind is allowed to be carnivorous and not merely vegetarian". He goes on to say, "In addition, the apparently harmonious order between animals and humanity that existed prior to the Fall will no longer hold; instead, the animals will dread mankind."[4] One wonders if he intended to write, "prior to the *Flood*". Victor Hamilton (1941–) is a retired Canadian/American Professor of Old Testament and Theology. He also teaches an explicit discontinuity between the antediluvian and post-diluvian worlds:

> "Not all the pre-Flood relationships will be restored. … Human exploitation of animal life is here set within the context of a post-Flood, deteriorated situation."[5]

As with the other writers already quoted, however, his discussion extends no further. Renowned biblical creationist Henry M. Morris (1918–2006) tentatively contrasted the 'dread of man' to mankind's original dominion (Genesis 1:28). Yet he noted that the world would ultimately remain under the sway of Satan (citing 1 John 5:19), even after the Flood:

> "Thus, man no longer was to exercise *direct* authority over the animal creation, as had apparently once been his prerogative, rather, there was to be fear manifest by animals, rather than obedience and understanding. … They were delivered into man's hand, in the sense that he was free to do as he would with them, though, of course, always as a responsible steward under God's jurisdiction [emphasis in original]."[6]

And, surprisingly perhaps, Morris had little more to say on the subject. German Hebraist and theologian Franz Delitzsch (1813–1890) commented similarly:

> "The dominion of man over the animals has no longer its original and inoffensive character ... he must now bring them into subjection by exerting himself to make them serviceable."[7]

Delitzsch thought God was simply informing people that they would now have the upper hand: "Into your hand they [will now be] delivered." However, they would have to work hard to subjugate the animals. This was now to include the eating of animal flesh because the comparative fertility of the pre-Flood world was no more.

A related, but rather more developed, concept is that God was explaining what the natural order of things was going to be like in the post-Flood world. Renowned Old Testament scholar Herbert Carl Leupold (1891–1972) was of this opinion. Accepting that God was intervening in some way, he believed this was solely for man's benefit:

> "There was really need of some such regulation. The beasts, by their great numbers, as well as because of their more rapid propagation, and in many instances also because of their superior strength would soon have gotten the upper hand over man and exterminated him. God, therefore, makes a natural 'fear', even a 'terror', to dwell in their hearts. Even the birds, at least the stronger among them, need such restraint."[8]

Furthermore, he says of God's statement in Genesis 9:2:

> "The truth of the fulfillment of this word lies in the fact that wild beasts consistently shun the haunts of men, except when driven by hunger. No matter how strong they may be, they dread man's presence, yes, are for the most part actually filled with 'terror' at the approach of man."[8]

Undoubtedly Leupold's insights are correct. Other writers have also seen the 'dread of man' as God's gracious protection from the predations of animals, notably Matthew Henry (1662–1714), the English pastor whose six-volume commentary of the whole Bible is still in print today. Henry says:

> "Those creatures that are any way hurtful to us are restrained, so that, though now and then man may be hurt by some of them, they do not combine together to rise up in rebellions against man... What is it that keeps wolves out of our towns, and lions out of our streets, and confines them to the wilderness, but this fear and dread?"[9]

However, acknowledging the useful wisdom put forward by such esteemed writers, I suggest there is more to the story. The divine injunction of "the fear and the dread" of man conveys that any confidence animals had until that point in history was thereafter shattered. While surely this *has* protected people from dangerous animals ever since, arguably there was a greater need for the animals themselves to be shielded from the excesses of man.

It seems surprising that few commentators have explicitly linked the forecast 'dread of man' with what immediately follows, namely the lifting of the ban on meat-eating. Animals obviously feared their animal predators in antediluvian times, as they do now; it was a matter either of fighting (in defence) or fleeing. If humans were frequently killing animals for food before the Flood, one would think they would have learnt to fear people, yet Scripture indicates that they lacked such fear. Today, over four millennia since the Flood, our experience that animals generally steer well clear of human beings tallies with what we read in Genesis 9:2, as the likes of Henry and Leupold observed.

Farming and finding food

It is seldom appreciated that biblical and secular anthropology sharply contrast when it comes to human dietary origins, the history of food procurement, the type of food eaten, and so on (see also part 2). Few of us can readily appreciate the investment of time and effort on the part of our ancestors, in order to acquire a sufficiently nutritious diet.

Before the advent of intensive agriculture and large-scale monoculture practices, obtaining the next meal was not simply a matter of visiting the supermarket. For several millennia of human history, much of the population had to work the land. The economies of peoples of antiquity were farming-based. This was true of ancient Egypt, for example; moreover, labourers' wages were paid in staples such as bread and beer because the first coins were not minted until around 500 BC.[10]

Image: Bunyuen Suksaneh

Figure 2. Mlabri people inside their shelter—a tribe of hunter-gatherers from northern Thailand and western Laos

Of course, they could hunt or fish for food—assuming a steady supply of wild animals, as well as the necessary skills and equipment to kill them. Scavenging what was left of predator-kills was another option. Or they could also spend considerable time foraging for wild plants (various fruits, roots, and tubers[11]), and other natural resources like honey. Hunter-gatherer tribes still exist today, such as the Mlabri people of parts of Thailand and Laos (figure 2).[12] But hunter-gathering has never been sufficient to support large populations.[13] It has almost always involved a nomadic lifestyle as the people sought out suitable prey animals.

Ideas of cultural evolution

There is a strong tendency for western people to view hunter-gathering as a 'primitive' life-style. For example, some have described the aforementioned Mlabri folk as a "Stone Age tribe",[14] a description that is clearly based upon evolutionary assumptions. The standard thinking among anthropologists has long been that agriculture is a relatively recent innovation. Allegedly, humans were all hunter-gatherers until 12,000–10,000 years ago. This was the time of the so-called Neolithic Revolution, when people started to settle down and farm the land in earnest.[15]

Within this mindset, human ancestors had previously existed for hundreds of thousands of years during the Palaeolithic era (aka Old Stone Age). During that entire period, evolutionists insist, there was no cultivation of the land for food. American cultural anthropologist Carol Ember, of Yale University's Human Relations Area Files, Inc., writes:

> "The hunter-gatherer way of life is of major interest

Image: Pixavay © Pexels.com

Figure 3. Obedient antediluvian humans were strictly vegetarian (per Genesis 1:29–30). After the Flood, God instructed the Noahic family to supplement their diet with meat (Genesis 9:3) and the thesis presented here is that this connects with God's imposition of the 'dread of man' upon wild animals.

> to anthropologists because dependence on wild food resources was the way humans acquired food for the vast stretch of human history."[16]

If evolutionists are correct, the majority of human history—sometimes dubbed 'technological prehistory'—took place in the Palaeolithic. This is not an inconsequential point of contention for, as the co-authors of a recent book allege, it was:

> "… *the period during which we became who we are* and began to realise our species' potential physically, socially, technologically, and linguistically. Examining this period helps provide answers to the fundamental question of *what it means to be human* [emphases added]."[17]

In this view, more than 99% of anthropological history predates our earliest written records. Worse, the assertion that our humanness gradually developed over deep time is diametrically opposed to the teaching of Scripture. Andrew Kulikovsky justly censures such teaching as a "secular and materialistic origin story intended to replace religious origin stories—especially the biblical creation account."[18]

Altered human diet and animal psychology

In the world before Adam's Fall, God intended that all human beings and terrestrial animals ("everything that has the breath of life") should be herbivorous, and we read that "it was so" (Genesis 1:29–30). Killing animals to consume their flesh was clearly off-limits. None of the animals to which God refers were originally carnivores. There was no death of *nephesh chayyāh* animals before the Fall.[19] Scripture is unambiguous about this, in spite of attempts by theistic evolutionists and 'old-Earth creationists' to assert otherwise.[20] Therefore, in the following centuries, and right up to the Flood, obedient humans were strictly vegetarian.[21]

But in the post-Flood world today, biblically speaking, a vegetarian diet is no longer obligatory. Most of us supplement our diet with meat, and the Bible explains this. Firstly, the sinful rebellion of Adam and Eve led to the whole created order being cursed (Genesis 3). The Edenic perfection having been shattered, corruption and death ensued. (Whether some antediluvians took to meat-eating is a matter we will consider shortly.) Secondly, nearly 17 centuries later, following the global judgment of the Deluge, God gave new instructions to the Ark survivors, as quoted at the head of this paper. The eating of animals was now expressly permitted (see figure 3). Indeed, the Genesis text indicates that meat-eating would have been a dietary necessity (discussed in part 2) for the early generations of people living in that immediate post-Flood world: "Every moving thing that lives *shall be* food for you. And as I gave you the green plants, I give you everything [emphasis added]" (Genesis 9:3).

However, just prior to this instruction, God had informed the favoured family of Noah of a revolutionary change to the animals themselves: "The fear of you and the dread of you *shall be* upon [every sort of animal]" (Genesis 9:2; my emphasis). The future tense, "shall be", is used in both Genesis 9:2 and 9:3. God was emphasizing a discontinuity between mankind's former vegetarian diet and the meat-rich diet which was to characterize their post-Flood existence; this is clear from God's own words, "[just] as I gave you the green plants". But first He informed them of a behavioural discontinuity regarding the relationship between humans and animals; in effect, 'the animals *shall* fear you from this day forward'.

From a plain reading of the text, the 'dread of man' seems to entail a radical alteration to animal sensibilities, a hiatus in their centuries-long perception of the benignity of humans. Having lacked suspicion of man before the Flood, they would now view humans with great anxiety and alarm. To argue that God was simply informing people that animals would tend to behave differently post-Flood is surely too prosaic. On the contrary, I believe Scripture is indicating that God supernaturally adjusted the minds of all types of animals—a wholesale psychological and biological transformation.

In part 2, we will see that this divine intervention was necessary to diminish the risks of extinction (especially in the early years after the Ark disembarkation), so conserving animal diversity. However, before discussing these and other ramifications, several qualifications must be made and potential objections faced.

Answering objections

The proposal that God supernaturally imposed the 'dread of man' upon animals will likely seem uncontroversial to

some readers, even intuitive perhaps. However, previous commentators on Genesis have not mentioned this possibility, seemingly because it did not occur to them. Perhaps, however, some have considered it but summarily dismissed it as unworkable. It is fruitful to anticipate, and answer, possible objections.

Antediluvian meat-eating surely widespread

Surely, some may argue, meat-eating in the period between the Fall and the Flood would have been commonplace? After all, the Bible is emphatic regarding the overflow of wickedness and the outright rebellion of the antediluvians (Genesis 6:5, 11, 12). That being so, is it not likely that some (many) would have engaged in meat-eating, contrary to God's mandate (Genesis 1:29–30)? And if so, should we concede that even God-fearing people ate meat after the Fall? Would this not have been especially likely after the institution of regular sacrifices, the aroma of burnt offerings whetting appetites?

After all, when God rejected the fig-leaf coverings which Adam and Eve had made for themselves (compare Genesis 3:7 to 3:21), He provided them with skin garments to cover their nakedness and shame. This obviously required shedding the blood of one or more innocent animals. Thus it represented the institution of atoning sacrifice.

By way of an initial answer, whatever one might surmise we must acknowledge that Scripture is silent about any meat-eating taking place in the antediluvian period. There is no hint that, as "*men* began to call on the name of the Lord" (Genesis 4:26) in those early centuries of history, including making burnt offerings, some human beings began to eat meat. Nevertheless, the majority of people find roasted meat delicious and pleasurable. Is it not likely, then, that the delightful aroma of sacrificial burnt offerings would have eventually led to the great majority of rebellious humans ignoring God's original mandate? If so, does this not weaken the force of the thesis, that the 'dread of man' (Genesis 9:2) was imposed to offset the greatly increased threat to animal survival with God's sanction of meat-eating (9:3)?

Clearly, we cannot possibly know how prevalent meat-eating was during that period. Some, perhaps many, may have done so. But is it actually so obvious that people *then* would have perceived meat-eating just as we do now? Even today, a significant minority of people are vegetarian, for a variety of reasons. One can legitimately ask whether the odour of roasting animal flesh would have been pleasing to people who had never eaten meat. Certainly, a number of vegetarians testify to having a strong antipathy for it. Not all vegetarians secretly crave meat! Also, the agreeable anticipation that most people experience upon smelling meat cooking may well be something learned. The person who has never tasted meat likely finds the aroma of steak much less enticing than do seasoned carnivores!

Image: Gerard Hoet, 1728 / Public Domain

Figure 4. "Then Noah built an altar to the Lord and took some of every clean animal and some of every clean bird and offered burnt offerings on the altar" (Genesis 8:20). The term "burnt offering" came into English via the Septuagint (Greek) translation of the Hebrew עלה, *`olah* ('to cause to ascend'); i.e. a holocaust, *Holokautein* (ὁλοκαυτεῖν), since no meat remained for consumption afterwards.

Moreover, a burnt offering was just that; the meat was not being 'cooked to perfection' but *burnt* up. Most people, whatever their dietary preferences, deem the smell of burning flesh to be very unpleasant. The entire animal was involved in a burnt offering; e.g. "the whole ram" (Exodus 29:18; Leviticus 8:21). This would have included the internal organs, skin, and wool. Medical professionals who use electrocautery[22] to remove unwanted skin growths and cancerous tissue, to cauterize skin lesions (thus sealing blood vessels), or to create incisions, find the smell very disagreeable. And everyone dislikes the fetid odour of burning hair, caused by the release of volatile sulfur compounds upon the thermal decomposition of its keratin protein.

That sacrifices offered by antediluvians would have taken the form of a "burnt offering" seems clear from Genesis

8:20, where Noah (who lived 600 years before the Flood) performs this very thing (figure 4). Long before the Mosaic Law, people were bringing sacrifices of burnt offering to God. A famous example is Abraham (Genesis 22:7–8, 13). God later instructed Moses, shortly after the giving of the Ten Commandments, that the people should bring "burnt offerings" (Exodus 20:24). While this came to be part of a much more rigorous institution of animal sacrifice than previously, the concept was not new. Then, of course, the rest of Exodus, Leviticus, and Numbers (and to a lesser extent Deuteronomy) are replete with references to burnt offerings. It was not cooking but burning; the flesh and entrails were *consumed* (e.g. Exodus 29:13).

Possibly, it might be objected that the Bible teaches otherwise. For example, "And the priest shall burn all of it on the altar, as a burnt offering, a food offering with a pleasing aroma to the LORD" (Leviticus 1:9). However, this is not evidence that the sacrifices would have gotten human stomach juices flowing. Rather, the "pleasing aroma" is explicitly said to be for God's benefit (and also in numerous other verses). It is figurative language, conveying that God is pleased to accept this sacrifice on behalf of the people. It is certainly not indicating that He is pleased with the odour of burning flesh!

Before moving on from this objection, one naturally assumes that Adam passed on the critical teaching concerning atoning blood sacrifice (Genesis 3:21) to his sons, for Abel knew this to be the acceptable way of approaching the Lord. Unlike his brother Cain, he brought "fat portions" of the firstborn animals of his flock (Genesis 4:4). Jesus even identifies Abel as a prophet, slain by his jealous brother (Luke 11:50–51). But there is nothing in Genesis to imply that people were holding back some of the meat for food. To maintain this view, one must read back into the text what we know of the provision for priests under the Mosaic Law (e.g. Exodus 29:27; Leviticus 7:31–35). We read of no divinely appointed priestly class before the Flood.

Instead, God's bar on meat-eating (Genesis 1:29–30) clearly remained in place right up to the time of the Flood. This is why He specifically addresses this very question in Genesis 9:3. God-fearing people would have shunned meat-eating. I suggest that it weakens the force of Genesis 9:3 if we suppose that most of the antediluvian people were already eating meat.

Not all animals fear humans

We are familiar with the fact that all sorts of wild animals generally give human beings a wide berth; and sometimes appear to be genuinely terrified of them.[23] Certain species are so shy and elusive that it is rare even to glimpse them. To snap an image or video footage of such a creature is newsworthy, as with a snow leopard caught on camera in 2014.[24] But if the 'dread of man' really was a divine imposition upon animals, why are there notable exceptions, such as reported cases where animals are fearless?

Records of explorers from recent history furnish examples of creatures which, for this very reason, were vulnerable to hunting and extinction. The dodo is a classic example—a flightless bird, endemic to Mauritius, driven to extinction by the late 17th century.

Another interesting example was recorded a century and a half later when English explorers, led by Captain Matthew Flinders (1774–1814), first landed on Kangaroo Island (South Australia). This island had not been inhabited by indigenous people and the kangaroos were initially unafraid of man, so much so that the ship's cooks were able to walk right up to them and club them to death. Flinders wrote, "In gratitude for so seasonable a supply [of kangaroo meat], I named this southern land KANGUROO ISLAND."[25] The tameness of animals of the Galápagos Islands is also well-known and will be explored more fully in part 2 of this paper.

These are fascinating cases. Yet a supernaturally induced 'dread of man' in Noah's 601st year does not rule out possible exceptions, especially so long afterwards. Genesis itself mentions the special case of domesticated animals, variously translated as "cattle" (KJV, NKJV, RSV) or "livestock" (ESV, NIV, NASB, NLT). These feature at creation (Genesis 1:24–26; 2:20), the Fall (Genesis 3:14), during the Flood (Genesis 7:14, 21; 8:1), and just after the Flood. Domestic animals are mentioned after God's words about the 'dread of man' (Genesis 9:10).

Also, certain species of zoo animals may become so accustomed to human contact that they exhibit little or no fear.[26] The same is true for certain animals which visit deliberately provided feeders near our homes (e.g. foxes, racoons, squirrels, and all manner of birds). At times of food scarcity or drought, desperate animals overcome their natural fear and may deliberately seek human help.

We know that "every kind of beast and bird, of reptile and sea creature, can be tamed and has been tamed by mankind" (James 3:7); but the word 'tame' is itself an indication that the wild state is the norm (figure 5). These exceptions to the rule are noteworthy precisely because a lack of fear in animals is unusual. (The biological basis of fear is discussed in part 2.) And several millennia on from the Noahic Flood, it is hardly surprising to find more exceptions, but they are anomalies. Possibly, the 'dread of man', albeit supernaturally imposed, had first to be 'triggered' in some instances. If so, it might explain occasional 'aberrations' of unusually tame wild animals to this very day.[27]

Man is only one predator of many

After the Fall, various animals surely began to attack and kill other animals. This would have been rampant for many

centuries before the Flood. Surely, therefore, fight-or-flight behaviours were already in place, and prey animals would have learned to hide and flee from their predators? If so, is this not a strong counterargument to the thesis that the 'dread of man' was supernaturally ordained?

Firstly, we must insist that the fossil record (largely a record of antediluvian life forms) unambiguously bears witness to the fact that attack and defence structures were employed by creatures from the earliest post-Fall times.[28] Thus, there were predators and prey. Among the fossils we find abundant evidence of tooth marks, bone puncture wounds, stomach contents, and coprolites (fossil dung) of carnivores incorporating animal remains. Secondly, it therefore follows that animals would have had essentially the same fight-or-flight responses that they have today. In other words, "an acute threat to survival that is marked by physical changes, including nervous and endocrine changes, that prepare a human or an animal to react or to retreat."[29] Fight and flight mechanisms are sophisticated and well-designed. They were created in the foreknowledge of God to help creatures survive in the post-Fall, cursed environment. As such, all these things would have been present before God's imposition of the 'dread of man'.

However, none of the foregoing negates that the 'dread of man' was a supernatural intervention at the end of the Flood. It was not "the fear and dread" of *other animals* which God said would be upon all beasts, birds, creeping things, and fish. Rather it was "the fear and dread of you [human beings]" (Genesis 9:2).

Nearly 1,700 years earlier, the Curse had also involved wholesale biological alterations to all living organisms—a point which is not controversial among biblical creationists. Genesis 3:14 says the serpent was cursed "above all livestock and above all beasts of the field"; that is, *all* were cursed. The Apostle Paul emphasizes this in teaching that the *entire* creation has been "groaning" ever since God subjected it to the "bondage to corruption" (Romans 8:20–22). Some of those changes would not have been especially obvious from physical appearances, rather behaviourally. In other cases, the changes to the appearance and/or behaviour of animals resulting from the Curse would have been more dramatic.

So yes, in the centuries between the Fall and the Flood, there was much animal violence, predation and carnivory, for which the fossil record furnishes plenty of evidence. Living creatures knew when to flee from other animal predators, but the biblical record *strongly* indicates that they did not take flight from man. To argue otherwise is to neutralize the force of God's words. Consider this comparison:

- "Cursed is the ground because of you; … thorns and thistles *it shall bring forth* …" (Genesis 3:17–18).
- "The fear and dread of you *shall be* upon every [type of living creature]" (Genesis 9:2).

Image: Alex Andrews © Pexels.com

Figure 5. Unusually tame animals are the exceptions that prove the rule—most wild animals fear human beings and give us a wide berth.

In stark contradiction to theistic evolution and 'old-earth' compromise positions, biblical creationists insist that prickly, spiny plants were *not yet* present in creation when God spoke those words to Adam. By the same logic, when God spoke to Noah's family after the Flood, animals did *not yet* fear people.

Conclusion

Following the creation (Genesis 1–2), the Curse was the first great biological juncture in world history, and must have followed quite soon after the completion of creation.[30] The world did not simply go haywire because of human sin. Rather God deliberately subjected it to its state of futility (Romans 8:20). I have proposed that the 'dread of man' represents a second biological juncture in world history. Although imperceptible as far as the physical appearance of the animals was concerned, its impact on their psychology was radical. I maintain that Genesis 9:2 speaks of a supernatural intervention. It is closely linked to God's mandate that, thereafter, every kind of animal would be potential

food for mankind (Genesis 9:2–3). God Himself highlights the specific and stark contrast between this and His original command regarding a vegetarian diet (Genesis 1:29).

Various objections to this view have been anticipated and answered. Aside from the question of whether some antediluvians ate meat (or to what extent), there is certainly little sport in slaughtering animals which do not turn and flee. And it is interesting that hunting is not mentioned in the Bible until Genesis 10 (see part 2). While some biblical creationists may deem this thesis an unwarranted, even hyper-literal, application of Genesis 9:2–3, it is biblically faithful. Furthermore, there are several important implications, which will be explored in part 2.

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Dread of man: part 2—fear, hunting, and human diet

Philip B. Bell

In part 1 of this paper, I proposed that the fear and dread of humans was supernaturally imposed upon animal minds just after the Flood (Genesis 9:2), and sought to answer objections that might be raised. Animal fear of humans is innate, but it stems principally from that point in history, rather than from creation. Part 2 is a more detailed examination of the implications of the thesis. After exploring the neurobiological basis of fear, some interesting exceptions to the 'dread of man' are noted, where wild animals are fearless of humans; hypothetical explanations are attempted. Informed speculation is also offered in relation to the transition between the antediluvian and postdiluvian periods. What did the Noahic family do for food immediately after leaving the Ark, and what about the succeeding generations? We consider dietary requirements, the history of hunting, and even the advent of gardening. Finally, we conclude with a hitherto apparently unnoticed contrast between the biblical creationist and evolutionary timelines.

Part 1 of this paper advanced the thesis that God's instructions to the Noahic family about the future 'dread of man' represented a wholesale supernatural alteration of animal sensibilities. God may have imposed this to help protect post-Flood people from animal violence. However, it was proposed that the main reason was to offset the greatly increased threat to *animal* survival arising from God's sanction of meat-eating:

> "The *fear of you and the dread of you* shall be upon every beast of the earth and upon every bird of the heavens, upon everything that creeps on the ground and all the fish of the sea. Into your hand they are delivered. Every moving thing that lives shall be food for you. And as I gave you the green plants, I give you everything [emphasis added]" (Genesis 9:2–3).

Assuming this proposition is correct, there are a number of interesting corollaries, which we will explore in this paper. It raises further questions too, such as: to what extent may fear be characterized biologically? Therefore, before further exploring the immediate post-Flood period we will take a short detour.

The biology of animal fear

The experience of fear, in humans and many animals, involves a surge in adrenaline. Both heart rate and blood pressure increase. The airways open wider, the pupils are dilated, and more glucose is delivered to the muscles. In fact, everything is primed for fight or flight. Although an innate response, animal fear seems to have been a supernaturally imposed biological juncture in world history. If so, it is worthwhile considering the means by which it was accomplished. This requires a short foray into neuroscience.

We know about physiological consequences of fear, but what exactly *is* fear? It is a singularly difficult question to answer. Ralph Adolphs is an expert on the subject: Professor of Psychology, Neuroscience, and Biology at Caltech Brain Imaging Center in the US. He commenced a major review (on 'The biology of fear') by noting the following:

> "Some argue that 'fear' is a psychological construct rather than something discoverable through scientific investigation. Others argue that the term 'fear' cannot properly be applied to animals because we cannot know whether they feel afraid."[1]

Not only is fear notoriously hard to define, there is a subjective element to our descriptions of animal fear; we cannot 'get into their minds'. "What is fear? The state evoked by threat. What is threat? That which causes fear," writes Adolphs. Yet he goes on to say that this definition of fear isn't actually circular because we may clearly observe the animal behaviour that results from fear.[1] A further problem is that much of our knowledge about the neurological basis of fear comes from *human* brain research. Therefore, conclusions of such research may only be tentatively applied to the subject of animal fear.

With those caveats, we may note a few specifics about fear in animals. Obviously, the threat of predators, stress caused by aggression of conspecifics, or the fear of pain, are first communicated to the brain through the senses. These are especially sight and sound, but also smell and somatosensory receptors. They trigger distinct regions of the brain's amygdala and hypothalamus. These in turn stimulate the periaqueductal grey, an autonomic region of the grey matter which is critical to involuntary responses to threat.[2,3] The latter releases chemical signals: steroidogenic factor 1 (in several species), and corticotropin, aka adrenocorticotropic hormone (across many more species).[4] Such secretions are involved

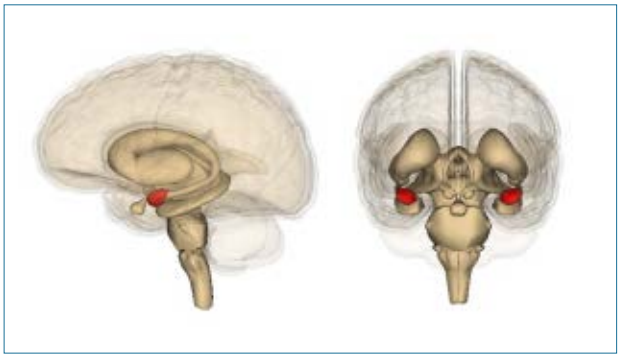

Figure 1. Side and front views of amygdala in the human brain

in regulating psychological stress and fear. Many parts of the brain's cortex, midbrain, and brainstem also cooperate in fear responses but the details are still poorly understood.[1]

The amygdala is the name for each of a paired cluster of grey matter near the brainstem, deep in the brain's temporal lobes, each inhabiting one of the cerebral hemispheres (see figure 1). It has a complex internal architecture neurologically. However, it seems to be a key mediator between many other brain regions that are involved in responses to stress, anxiety, and fear (and in humans, phobias too). As well as receiving most of the fear-associated sensory inputs, the amygdala is also widely believed to regulate most of the outputs associated with animals' fear responses.

In considering the 'dread of man', it is pertinent that the amygdala's role in fear processing seems to be basically the same across numerous creatures. These include: humans,[5] monkeys,[6,7] rodents,[8,9] and even reptiles[10] (refs. from Adolphs[1]). Although the neurological basis of animal fear is still poorly understood, this ubiquity of the amygdala's central role in fear responses is fascinating.

It seems likely that the 'dread of man' was indeed occasioned by a divine neurobiological intervention. Thus we may legitimately conjecture that God somehow altered the function of animalian amygdalae, and perhaps also related brain regions and pathways mentioned earlier. A comprehensive discussion of this point is far beyond the scope of this article, but it would make a fascinating research study for a creationist with a keen interest in neuroscience.

How might the fear response be lost?

Part 1 of this paper briefly discussed interesting exceptions to the rule, that animals "fear and dread" humans (Genesis 9:2). Some animals seem quite fearless of humans: domesticated creatures, many zoo animals, and wild animals which become habituated to people who feed them. Moreover, there are historical records of explorers encountering naive wild animals that were seemingly without fear.

Animals of the remote Galápagos Islands are a further intriguing case in point, 605 miles (973 km) off the coast of Ecuador. As was true of Australia's Kangaroo Island (see part 1), the animals of the Galápagos appeared to be extraordinarily tame when they were first discovered in the 16th century, and most retain their fearlessness today.[11,12] The flora and fauna of the islands have been protected through active conservation efforts since the 1950s. All sorts of birds, marine iguanas,[13] sea lions, and giant tortoises, either take no notice of humans, or even seem curious and approach them quite closely. Prior to the mid-20th century, animals of the Galápagos had already experienced contact with humans for at least four centuries. According to Carl Wieland:

> "This suggests that the fear of man is not learned, but may be largely programmed genetically, like other instinctive behaviour. If the program is lost, e.g. during speciation, it won't get 'rewritten' via experience."[11]

Exactly when did this 'dread of man' get programmed into the DNA of diverse kinds of animals? Obviously, the thesis of these two papers is that it occurred some 1,657 years after creation (Genesis 9:2). Wieland observes that, compared to the tame animals of the Galápagos, "the same types of creatures on the South American mainland have the 'normal' fear of man."[11] Clearly, the alteration to the fear response of island animals, such as those of the Galápagos, must have happened a long time before the first post-Flood people arrived.

But, *how* exactly might animal fear responses wane, or get deleted? The answer is likely to be different in different cases (see figure 2). As one possibility, I hypothesise that a mutational abnormality occurring in a small island (or other isolated) population could have led to a break in the neurological transmission of fear. A useful analogy can be drawn with blind cave fish. They may lose the ability to see through a mutation that switches off (or corrupts) the genetic instructions for making eyes. This does not disadvantage them in the pitch-black environment of a cave where sight is useless; arguably, it may even be an advantage since eyes could be scuffed against the cave walls, so leading to infection.[14]

Similarly, imagine that a mutation alters some aspect of the brain's circuitry or neurotransmission, perhaps in the amygdala, or the periaqueductal grey. It would be something that is crucial to the animal's ability to fear danger. If this occurred in a small, isolated population, in the absence of predators, the loss of fear would pose no problem. It might actually be an advantage, saving energy that would otherwise be wasted in avoiding non-existent conflict or predation. According to Daniel Blumstein (professor at the Department of Ecology and Evolutionary Biology, and a professor for the Institute of the Environment and Sustainability, at the University of California, Los Angeles), fear is costly. He cites several examples, one of which is,

> "Foraging in the open, flocks of birds expend valuable energy by quickly taking flight, en masse, when a raptor appears. While they successfully escape the raptor, the birds leave behind their food source."[15]

Excessive vigilance in animals would likely divert them from engaging in important activities.

In any case, our hypothetical mutant allele (for fearlessness) would conceivably become fixed in the population. We deem sightless cavefish an oddity, though they are clearly descended from sighted fish, which is why they can still hybridize with them in many cases.[14] Similarly, fearless wild animals may be quirky descendants of animals which were 'wired' to fear humans (as predators) just after the Noahic Flood (Genesis 9:2). Such cases, where the fear response has been *lost* through mutation, would likely be irreversible. That is, the reintroduction of predation would not be expected to overwrite their fearlessness.

How else might the normal fear response be lost? After the supernaturally imposed 'dread of man', it is probable that some animals dispersed to remote locations where they remained entirely isolated from encounters with human beings until relatively modern times. Intuitively, we might expect that such long-term isolation led to waning of the fear response (discussed shortly). This would especially be the case in the absence of significant predators, for instance on small islands. Mechanisms of dispersal, then isolation, are readily suggested within the biblical model of history. The two principal means of dispersal in the years after the Flood would have been over land, and over sea on log mats.[16,17] Additionally, centuries later, a fairly rapid rise in sea level with the declining post-Flood Ice Age would have flooded the coastal margins, thus submerging land bridges, and low-lying land masses.[18] The consequent formation of islands and archipelagos ensured the isolation of the fauna.

Why might the long-term isolation of animals from major predators—especially human beings—have led to a waning of the 'dread of man'? Perhaps it occasionally needs 'triggering' by some imminent threat of predation that acts as a fear stimulus. This would be reversible though, distinct from tameness arising from a mutational defect (discussed previously). Possibly, this might happen through natural selection acting on natural variation in an animal population. Without the threat of violence, there would be no selection of the more skittish, flighty individuals. Tameness would increase. Alternatively, maybe epigenetic changes can cause a waning of animal fear, reinforced over several generations of non-arousal.

Daniel Blumstein concurs with the latter hypothesis. He and colleagues researched tammar wallabies on Australia's Kangaroo Island, where there have never been terrestrial mammalian predators. Then they compared them to the same wallabies in suburban, predator-free New Zealand. The New Zealand tammars had been introduced 130 years earlier from the Australian mainland where there were many such predators. When exposed to red foxes, they were surprised to find that the Kangaroo Island tammars responded fearfully. However, the tammars from New Zealand did not. Blumstein "hypothesized that a predator recognition template had essentially disappeared through disuse."[19] It seems that the Kangaroo Island tammars retained a degree of antipredator behaviour because they are predated upon by the large, wedge-tailed eagle.

Image: Luca Nardone © Pexels.com

Figure 2. Animal fear is incompletely understood, as are the exceptions of tameness.

Tameness might also be essentially a learned behaviour, animal offspring emulating their parents who, for many generations enjoyed the luxury of living without the threat of predators. That is, the young had no opportunity to learn avoidance or flight behaviours. Or it might be a combination of the two. Veterans of ethology (animal behaviour) know not to disallow the possibility of new and unusual behaviours arising, even in cases where they are extremely familiar with their animal subjects.

The immediate post-Flood period

After the Flood, God explicitly instructed Noah and his immediate family (and by extension, the generations to follow) that "every moving thing" (Genesis 9:3) could be eaten. Therefore, He also ordained that every "beast of the earth ... bird of the heavens … everything that creeps … and all the fish" would flee from people in fear. The two things are linked. Unless God had so modified the psychological makeup of the animals themselves, the slowest and tastiest creatures would have been quickly driven to extinction!

In other words, apart from their own livestock, procuring the meat of wild animals in the post-Flood world was not going to be a case of simply walking up and snatching any beast or bird that took their fancy. Yet, it seems they could have done so before the Flood, had they been so inclined.

Image: Petr Ganaj © Pexels.com

Figure 3. The violence of the antediluvian period (Genesis 6:11) included that of animals, as attested by fossil remains of both defence and attack structures, and wounds. Some of that violence would have been directed towards humans too.

Postdiluvian people would have had to learn to trap and hunt now-evasive living creatures, requiring cunning and the mastery of new skills.

Taking Genesis 9:2 and 9:3 together, God was sanctioning hunting. I have argued that His transformative intervention was a key event in biological history. It was also a vital one. Without it, the future of animal kinds would have been especially precarious in the immediate aftermath of the Flood, when both terrestrial and marine animal populations had been devastated. The animal populations leaving the Ark were limited to founding pairs, or seven pairs (or sevens) of the clean animals.[20] Eating any of the *single* pairs of animals immediately after the Flood would have been problematic to say the least! However, as soon as the animals were allowed out of the Ark, they must immediately have dispersed (excepting the livestock), as now fearing and dreading human beings. This would have averted the risk of immediate human-caused extinction!

Obtaining adequate protein was not an urgent problem for the family of Noah. We may reasonably assume that the eight of them initially relied on left-over stores from the Ark. This would have been important during the time newly planted crops were growing (conceivably only 3–4 months).[21] They likely did some fishing too. Later on, as Shem, Ham, Japheth, and their respective wives had families of their own, they would certainly have eaten regularly and sustainably from their domestic flocks. More individuals of the livestock kinds had been taken onto the Ark, so their numbers would have increased fairly quickly, a reliable and important protein source for the small founder population of human beings.

The development of hunting

In the years and decades following the Flood, human longevity, although significantly reduced, was still far greater than it is today (Genesis 11:10ff). That, and the greater fecundity of those times, would have ensured a rapid population increase in the decades following the Flood. Within say 20–30 years, plant and tree cover would have mushroomed, animal population densities would have substantially increased, and numerous species must have established themselves in diverse niches and habitats. As Noah's grandchildren and later generations multiplied and roamed a bit further from their home range (Genesis 11:2); albeit within the vicinity of "the land of Shinar"), their encounters with animal descendants of the Ark's founding pairs would have become more frequent. People would increasingly have trapped and hunted animals for food (as per Genesis 9:3).

Prior to the Flood, it is unlikely that the killing of animals *for human food* was widespread. Also, a straightforward conclusion of Genesis 9:2 is that antediluvian animals were not afraid of people. Can we meaningfully say, then, that animal hunting occurred during that period? To hunt is "to chase and kill (animals) for food or sport."[22] People may well have killed animals, but these would not have fled, so there would have been little satisfaction or reward in the act. There is little sport without the chase; merely gratuitous slaughter.

Nevertheless, since animals were easy to catch, one would think that their skins (particularly of domestic livestock) were used for leather clothing, and pelts for warm garments. They were surely traded too. Leather clothing is very hard-wearing so can be worn for a long time. It would have required the killing of far fewer animals than would be the case if they were being eaten. Those animals which yielded the most desirable and suitable skin products would have been kept and bred for that purpose. Certainly this is a much more reliable and consistent strategy than going out and killing a wild beast at random.

On the other hand, Scripture records that "the earth was filled with violence" before the Flood (Genesis 6:11). The context is the terrible corruption and evil of the antediluvians (Genesis 6:5, 12), so the violence referred to must particularly be that of depraved human beings. Tragically, we know this included vengeful murder (Genesis 4:8, 23). Man hunting man was not unknown. Indeed, upon being punished by God for murdering his brother Abel, Cain feared being hunted down and killed, so God put a mark on him (Genesis 4:14–15).

Yet *all creatures* were corrupt through the ravages of the Curse, so attack and defence mechanisms had been part and

parcel of animal interactions since nearly the dawn of history, as also evidenced by the fossil record (see part 1). Consequently, the 'violence' of that period embraced animals. This surely included both animal-vs-animal and animal-vs-human violence (figure 3).

Certain wild beasts, since fearless, may seriously have imperilled the lives of pre-Flood people, more so than is the case today. That is not to say that none of them were cautious or wary of humans at all, or that they lacked any protective instinct whatsoever. No doubt, some that were fairly docile (particularly larger animals) would have put up a fight as soon as a hostile attempt on their lives became obvious. Killing such creatures would surely have been more dangerous than it is today, precisely because they did not fear man at that period of history.

As indicated in part 1, some commentators on Genesis have suggested that God instilled terror into wild animals post-Flood to protect post-Flood people from being themselves hunted by animals.[23] But before that time, taking on formidable, troublesome animals (especially larger predators) in order to kill them was likely an occasional necessity for antediluvian people. It may even have been deemed a dangerous pleasure by some of them—not so much hunting as mortal combat. I suggest the killing of animals during that period of history mostly functioned to maintain people's security and safety. There is no biblical indication that people ate animals. Moreover, it is unlikely to have been commonplace because a straightforward implication of Genesis 9:3 is that no pre-Flood dietary impulse was driving people to obtain protein through carnivory (discussed in more detail later).

Nimrod the hunter

Keeping in mind these musings about hunting, it is fascinating to read the biblical record of Nimrod, one of Noah's great-grandsons in the line of Ham:

> "Cush fathered Nimrod; he was the first on Earth to be a mighty man. He was a mighty hunter before the Lord. Therefore it is said, 'Like Nimrod a mighty hunter before the Lord'" (Genesis 10:8–9).

That Nimrod "was the first on Earth to be a mighty man" is also recorded elsewhere (1 Chronicles 1:10). It may, instead, be rendered "He began to be a mighty man on the earth". In other words, just two generations after the disembarkation from the Ark, men were vying with each other as hunters, and Nimrod stood head and shoulders above the rest.

Many Bible scholars believe that the Hebrew text behind "before the Lord" is better rendered "*against* the Lord". This would tie in very well with other information about him. It was Nimrod who founded and ruled the city of Babel and other cities, notably Nineveh (Genesis 10:10–12)—identifiable with Sumerian culture.[24] Consequently, it is very likely that Nimrod actually *led* the rebellion at Babel (see Genesis 11:4). That was itself the occasion of God's judgment when

Image: David Scott, 1832 / Public Domain

Figure 4. Painting of Nimrod, having just slain a wild animal

He confused the one language spoken up until that time (Genesis 11:6–9).[25]

Nimrod's prowess and prestige as an elite hunter (figure 4), although a rebel as far as God was concerned, suggests that he was brave and successful in tackling large and formidable animals. Especially before the Flood, these would have been a threat to human beings. Perhaps he even took on some of the larger dinosaurs. Correspondingly, we ourselves need only look back a few generations, to the 19th and early 20th century (prior to modern-day concerns of ecology and conservation), to read about big game hunters going on safari to hunt large and dangerous wild animals.[26]

Dietary issues

Permitting the killing of potentially dangerous animals is one thing, but why did God specifically sanction meat-eating following the Flood (Genesis 9:3)? His explicit statement indicates that it was going to be important for human health.[27] Surely this was because of the vast difference between the luxuriant, productive pre-Flood environment (see the glimpses of this given in Genesis 2:6 and 2:10–14) and the devastated world in which human Flood survivors now found themselves? Many plant types with which Noah's family had been familiar before the Flood were now scarce or extinct. It was going to be tougher to get adequate nourishment from

Image: Maarten van Heemskerk / Public Domain

Figure 5. 19th century depiction of the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World. The Tower of Babel appears in the background.

plants than had previously been the case. That would especially have been so without the advanced dietary knowledge we possess today.

God's lifting of the bar on meat-eating ensured that people could ingest sufficient protein and obtain essential nutrients (particularly the irreducibly complex vitamin B12, or cobalamin[28]), ensuring a balanced diet and healthy bodies. This would have been especially important during the interim phase when the land was being settled and brought into crop production. For example, "Noah began to be a man of the soil, and he planted a vineyard" (Genesis 9:20), but it would have taken time to reach maturity.

Thinking further about vitamin B12 may throw more light on our subject. Usually obtained from dairy products, eggs, and meat, B12 is vital for the metabolism of both amino acids and fatty acids, and more besides.[29] Plants lack this essential dietary factor. For this reason, vegans (strict vegetarians who exclude even dairy, eggs, honey, and any other animal products) risk deficiency-associated problems unless they take supplements or eat cereal grains fortified with it. However, it is conceivable that some plants in the antediluvian period might have been sources of vitamin B12.

Alternatively, perhaps certain bacteria of a person's healthy gut biota provided it. Among the commensal and probiotic flora of the human gut are bacteria (notably *Lactobacillus sp.* and *Bifidobacterium sp.*) which can synthesize water-soluble vitamins. A few studies of *Lactobacilli* have shown limited vitamin B12 synthesis in the human gut which, if it could be properly harnessed, might mean vegans could avoid reliance upon exogenous sources of the vitamin.[30] However, this seems unlikely because most of the microbial activity producing vitamin B12 occurs in the colon. The receptors necessary for absorbing it are found 'higher up' in the ileum.[31]

Other herbivorous mammals get round this problem through rumination (chewing the cud) or coprophagy (eating a portion of their own dung). Is it possible that antediluvian people were endowed with sufficient vitamin B12 synthesis, by microbiota of the small intestine,[32] to provide their dietary needs? Maybe, but it would not have been necessary. Keeping sheep began in the earliest generations of mankind (Genesis 4:2) and doubtless they kept other domesticated creatures like chickens. They were vegetarians, not vegans, so the consumption of milk and eggs would have provided them with all the vitamin B12 they needed without needing to kill any *nephesh chayyah* (living, breathing creatures).

Evolutionary timeline re: human hunting and agriculture

What we have looked at so far contrasts strikingly with the evolutionary scheme. We noted in part 1 (the section: *Ideas of cultural evolution*) that generations of people have been led to believe our ancestors were hunters for long ages of time, often misnamed 'prehistory'. In addition, that they only took to farming very late in their developmental timeline. So-called prehistoric human societies were supposedly hunter-gatherers, so only with the Neolithic Revolution did people begin to cultivate the land to grow crops.

Prior to that time (said to be about 12,000 years ago), during the so-called Pleistocene, it is alleged that there were numerous cycles of glaciation (Ice Ages). Glacial periods (ice advancement) were interspersed by warmer periods (interglacials) when the ice cover was less extensive—all of this envisaged to stretch back to 2.6 million years ago. All through the Pleistocene, with the waxing and waning of ice sheets, humans supposedly were gradually evolving from more primitive hominid ancestors. They hunted and fished, or foraged for what food they could find. According to secular anthropologists the simple innovation of farming the land never occurred to these human ancestors!

However, the scientific evidence being interpreted in support of multiple ice ages (some 'dated' to over two billion years ago)[33] fits much better with a *single* Ice Age following the Deluge described in Genesis 6–9.[34] Also, we have seen that the implication of Genesis 9:2–3 (supported by the information about Nimrod in Genesis 10:8–9) is that the widespread hunting of animals *for food* did not occur until after the Flood. Prior to that time, people were agriculturalists, cultivating the ground to raise food crops.

The advent of gardening

There is a further contradiction between the biblical timeline of human industriousness and that given by evolutionists: the onset of gardening. In a sense, gardening (horticulture) is a specialized form of cultivation. Certainly, there is good archaeological and literary (textual) evidence that the ancients were involved in gardening. They were adept at terracing, landscaping, and the cultivation of plants, both for

Table 1. Contrast between evolutionary and biblical anthropology with respect to the timing of cultivation

Timeline	Step 1	Step 2	Step 3
EVOLUTION	**Hunter-gathering** ca. 1.8 million years[37]	**Agriculture** 10,000–8,000 BC	**Gardening** 1,800 BC (Mesopotamia)
GENESIS	**Gardening** 4,000 BC (Genesis 2:8–10, 15)	**Agriculture** Began in earnest post-Fall[36] (Genesis 2:5, 3:17b–19)	**Hunting** 2,400 BC, after the Flood (Genesis 9:3, 10:9)[38]

food and for ornamental purposes. For example, this was happening c. 1,800 BC in ancient Mesopotamia, and there are also the famed Hanging Gardens of Babylon from the sixth century BC (figure 5).[35] Such facts are entirely in keeping with the Genesis record and timeline. The Old Testament as a whole is replete with references to elaborate and rich gardens, notably during the reign of Solomon, c. 970–931 BC (e.g. Ecclesiastes 2:5; Song of Solomon 4:15–16, 6:2).

The newly created Adam found himself in a flourishing garden right at the start (c. 6,000 years ago):

> "The Lord God took the man and put him in the garden of Eden to work it and keep it" (Genesis 2:15).

In fact, Adam and Eve were originally instructed to live off the produce of the plants and trees of Eden, except for "the tree of the knowledge of good and evil" (Genesis 2:16–17). Scripture teaches that agriculture followed quickly, although the Fall meant that the work would now be arduous and painful (compare Genesis 2:5 and 3:17–19).[36]

Contradictory worldviews

We have considered several discrepancies between the secular and biblical teaching about human industry and behaviour. Table 1 summarises the contrasts between these two very different timelines.

Theistic evolutionists and 'old-earth creationists' who adopt the conventional secular timeline for anthropological origins are confronted with yet more contradictions here. The evolutionary trajectory from hunter-gathering to agriculture to gardening is in the opposite direction to the trajectory plainly taught in the Word of God. We can further summarize these contradictory views explicitly in terms of animal killing:

Evolutionary worldview: human ancestors were involved in the death and bloodshed of untold billions of animals for hundreds of thousands of years *before* discovering that they could subsist much more effectively by tilling the land for food. Gardening was a *very recent innovation* from this secular perspective.

Creation worldview: there was no death of animals originally as man was initially *created to be a gardener*, then for centuries humans tilled the land to obtain food. Apart from sacrifices, Scripture seems to indicate that the widespread killing of animals for food (certainly by covenant-keeping people) only took place after the globe-destroying catastrophe and a *divine mandate* to do so.

There is an exception to the latter, regarding sacrifices. This goes back to the sobering occasion when Adam and Eve were clothed with garments of animal skin by God Himself (Genesis 3:21). He provided and made those 'skin coats' to deal with their sense of nakedness and shame, brought about by their sin against God. It was an act of human rebellion that necessitated God's slaying of one or more innocent animals. Importantly, God was literally making a covering (Hebrew *kaphar*[39]) for sin—an atonement—involving the shedding of animal blood. This was a vital means of bringing about the reconciliation of repentant rebels with God, through their cleansing and the forgiveness of their sins (see 1 John 1:9). This was not just an object lesson for Adam and Eve, teaching the necessity of blood sacrifice as the only means to get right with God (c.f. Hebrews 9:22). It also pointed forward to Jesus' perfect atoning sacrifice for sins, as prophesied in Genesis 3:15.

God's provision of skin coverings for Adam and Eve dramatically emphasized the seriousness of sin. Much later, their son Abel (by this time a grown man with a prophetic ministry; Luke 11:49) knew to bring "of the firstborn of his flock and of their fat portions" as an acceptable offering to God (Genesis 4:4, cf. Hebrews 11:4). Cain *should* also have known that a blood sacrifice was required, as shown by God's rejection and rebuke (Genesis 4:5–7). However, as discussed in part 1, God's institution of sacrifices was not a signal that people could slay animals *for food.* Rather, that was something which God did not sanction until nearly 17 centuries later (Genesis 9:3–4).

Conclusion

When reading about the immediate post-Flood period in the Genesis record, we should not too quickly pass over the scriptural statement about the 'dread of man'. In both parts of this paper, I have argued that Genesis 9:2 represents a biological discontinuity. God supernaturally intervened at this point in history, so altering the way in which all animals would thereafter perceive human beings. This is closely tied to the lifting of His own injunction against meat-eating back

at the dawn of humanity.[40] On this basis, we also learnt several lessons about biblical history, further reinforcing its incompatibility with secular evolutionary thinking. What is more, zoologists and ethologists (certainly creationist ones) would do well to bear this event in mind, in seeking fully to comprehend psychological aspects of animal makeup and behaviour.

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An Upper Mesopotamian location for Babel

Ken Griffith and Darrell K. White

The authors follow three lines of evidence that all point to Upper Mesopotamia as the origin of human civilization and the most likely location of Babel. The lines of evidence are archaeological, biological, and historical. The evidence points to a specific site whose mound has never been excavated. This is the first of two papers that present evidence for a Babel site and an Ark site located 50 km apart near Diyarbakir, Turkey.

The Tower of Babel should be one of the most enduring monuments of antiquity. Unlike mud bricks which melt back into the earth when exposed to rain, the city and tower of Babel were built of fired bricks mortared with asphalt. Ceramics are able to resist the elements for tens of thousands of years. At the very least, the foundations of Babel should still be there today.

Though there are many local traditions, to date Babel has not been positively identified. Nearly every ruined ziggurat in the Middle East today is named after either Nimrod (Birs Nimrud) or some form of the name "barsip" which means "tongues" in Semitic languages.

Since Babylon is in lower Mesopotamia, and that is where the Jews were taken into captivity by Nebuchadnezzar, most historians have assumed that Babel and Babylon were the same city, or at least the same region. Thus, the Esagila of Babylon should be the tower of Babel, according to this view.

Archaeologists have found that Babylon was first built in the Akkadian era, centuries after the oldest cities of Sumer, making it one of the later cities built in the region of Sumer and Akkad. The biblical text tells us that Babel was the first of Nimrod's cities in his first kingdom in the land of Shinar. This creates an apparent contradiction between the Bible and archaeology.

Nebuchadnezzar himself seems to have believed the ziggurat of Borsippa, 30 km south of Babylon, was the Tower of Babel. He renovated it and left foundation bricks telling how in previous times they had laboured building it for 42 years, or cubits, but left it unfinished.[1]

David Rohl made the case that Babel was the Sumerian city called Eridu, which lay 150 km south-east of Babylon.[2] Douglas Petrovich seconded Rohl's hypothesis in the video series, "Is Genesis History?"[3] Thus, the emperor of Babylon at its apex (Nebuchadnezzar), and some scholars over 2,000 years later, share the opinion that the Esagila of Babylon was not the location of the Tower of Babel.

Sayce[4] and Albright[5] both suggested that Babel might be found in Upper Mesopotamia. More recently Habermehl[6] made the case for the Khabur Triangle in Eastern Syria as Shinar.

In this paper we will present evidence suggesting that there were two Babylons, though not in the sense of Hislop. The Babylon of Nebuchadnezzar was the second Babylon, in a similar sense that the York on Manhattan Island is New York, not the original York in Northern England.

There are biblical, historical, and archaeological witnesses that point to where the original Babylon lay. If we follow them, they point to a specific site which has never been excavated.

What is known

The biblical narrative relates that after the Flood the descendants of Noah began to build a city and tower called Babel, which was to be a tower "reaching to the heavens" for the purpose of making a name for themselves (Genesis 10–11). After the confusion of tongues mankind dispersed from Babel and formed the nations of the world. However, the Babel event of chapter 11 appears to be out of sequence, and must have occurred prior to the migrations to the territories of the nations recorded in chapter 10.

When early archaeologists, adventurers, and treasure hunters began to dig up the Middle East in the 19th century, they found cities, temples, and ziggurats with writing on clay tablets. These were determined to be some of the oldest cities in the world.

The oldest cultural layers of Sumer and Akkad are defined by archaeologists as the Ubaid, Uruk, and Jemdet Nassar Periods. These were the earliest urban periods in lower Mesopotamia. However, they are not the oldest urban settlements on the planet. That distinction belongs to a culture that Kathleen Kenyon defined as the Pre-Pottery Neolithic A, or PPNA.[7]

The Neolithic is defined as being younger than the Paleolithic and Mesolithic cultures, which did not build permanent settlements or practise agriculture. However, this

Image: Bjoertvedt / CC BY-SA 3.0

Figure 1. Pre-Pottery Neolithic A distribution

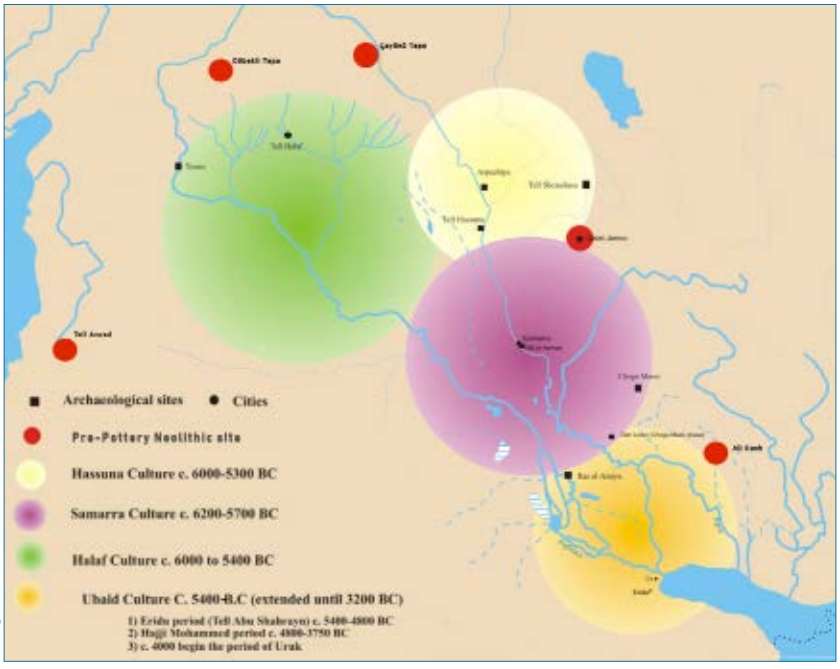

Image: Jolle / CC BY 3.0

Figure 2. Oldest cultural layers in the Middle East

seems to be an unfounded assumption of evolutionary thinking. The unquestionable premise of evolution is that man was a hunter gatherer before he became a farmer. Therefore, the widespread campfires and burial caves of the Paleolithic hunter gatherers must be older than the Neolithic, including the PPNA.

However, ceramics including pottery have been found at Paleolithic sites on the Adriatic, as well as in China, and Japan. In the biblical narrative we see farming and city building with fired bricks immediately after the Flood. Therefore, a biblicist might conclude that Paleolithic and Mesolithic hunter-gatherers were actually a parallel culture or mode of living that was mostly after the Dispersion, and therefore concurrent with or after the PPNA.

The Bible states that Noah was the first farmer after the Flood (Genesis 9:20). In archaeology the 'Neolithic' are considered the first farmers, and the PPNA is the oldest known Neolithic culture. Therefore, we expect that the PPNA is a good place to look for the Tower of Babel.

The PPNA sites are located in the mountains and valleys of upper Mesopotamia (figure 1). There are no known PPNA sites in lower Mesopotamia where Babylon lies. This poses a major problem for the conventional understanding of Babel. However, there are intermediate settlements called the Hassuna and Samara cultures going down the Tigris River from the PPNA toward the later Ubaid culture of Uruk (figure 2). Smith asserted that Çatalhöyük, a PPNA site, was one of the first cities built after Babel,[8] which agrees well with our thesis that the PPNA represents the culture of Babel and the two centuries immediately after the dispersion.

Returning to the biblical narrative, let's make a list of the features that we are told about Babel, and we can consult some other sources as well.

We are told that Babel was the first of four cities in Nimrod's first kingdom, and that it was on a plain called Shinar. The four cities were Babel, Erech, Accad, and Calnah (Genesis 10:10).

From four extra-biblical sources including the Sybils, Polyhistor, Abydenus, and Jubilees, we read that the construction of the tower was stopped by a terrible wind.[9,10] The Midrash, another ancient source, states: "As for the unfinished tower, a part sank into the earth, and another part was consumed by fire; only one-third of it remained standing."[11] These traditions could be a reference to volcanic activity near Babel such as a pyroclastic flow accompanied by an earthquake.

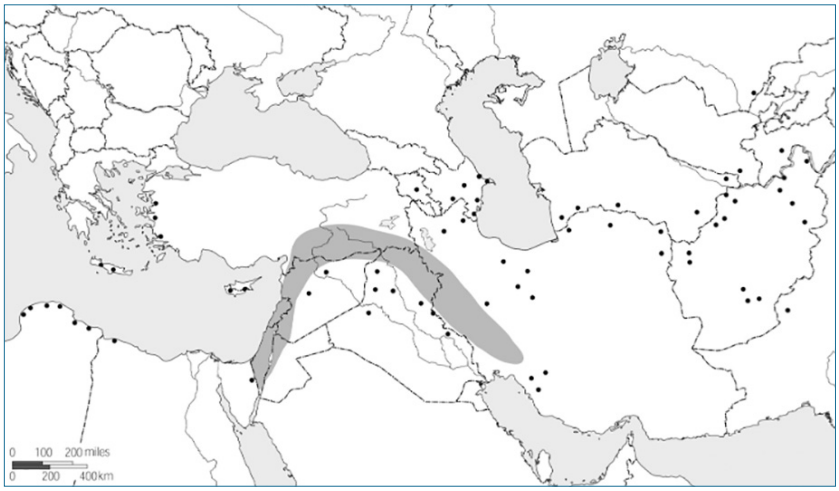

Image: Zohary, Hopf, and Weiss, 2011

Figure 3. Distribution of wild barley

Humphreys[12] argued that the city of Babel lay on an east-west axis with the ark, based on the frames of reference in Genesis 9 and 11. Since the city and tower were built with burned bricks, then we might expect to find a kiln where the bricks were fired. The use of bitumen requires a local source of tar or trees from which plant-based bitumen was derived.

We can build a list of features that we will expect to find at the Babel site:

- Situated within the oldest urban cultural layers on Earth
- At the centre of the dispersion of nations
- Near the centre of the first Neolithic farming
- On a plain called Shinar ("Shee-nar" in Hebrew)
- Four associated cities: Babel, Erech, Accad, and Calneh
- Evidence of firing bricks in a kiln
- Local source of tar
- Structures made of fired brick and asphalt mortar
- On an east-west axis relative to the Ark or Altar site
- Possible volcanic activity.

Lastly, we might expect that Babel may have been reoccupied after the dispersion event. It was an excellent location, and it already had kilns as well as houses and other city infrastructure made of fired bricks that could not be carried away. Whichever tribe stayed behind and claimed that valley after the others had dispersed would have found Babel to be low hanging fruit for resettlement.

Archaeological and biological evidence

Looking at the map of the sites of the Pre-Pottery Neolithic A (figure 1), we find a distribution with three horns, roughly centred on the city of Diyarbakir, Turkey. The three horns go out from the centre: west along the Mediterranean coast to the Aegean, southwest to Canaan, and south-east along the Zagros mountains toward what would become Elam and today's Iran. There are also a few outliers in Upper Egypt. The centre of the PPNA distribution is on the bend in the Tigris River just south of Diyarbakir, Turkey. This suggests that the region of Diyarbakir might be fruitful to investigate for evidence of Babel.

Biological evidence

The oldest biological ancestors of einkorn wheat, emmer wheat, barley, peas, chickpeas, lentils, and flax are all found with similar distributions. These were the founder crops of the 'Neolithic Revolution'. Their distribution is roughly centred on the mountain called Karaca Dag (pronounced "karaja dah"), which is about 30 km west of Diyarbakir.[13] Weiss's paper has seven more maps similar to figure 3 for the other seven founder crops.

Note that the 'fertile crescent' for the neolithic founder crops *does not include* the plain of lower Mesopotamia where Babylon is located. The alluvial plain of Lower Mesopotamia may have still been part of the Persian Gulf for several centuries after the Flood.[14]

Archaeology and biology both suggest that the origins of human civilization and farming began between the Euphrates and Tigris rivers in the region of Diyarbakir, Turkey. For now, we will not be concerned with radiocarbon dating suggesting these sites are 10,000 years old. If we ignore the conventional chronology which may be based on mistaken assumptions, we find the evidence fits the biblical narrative quite closely.

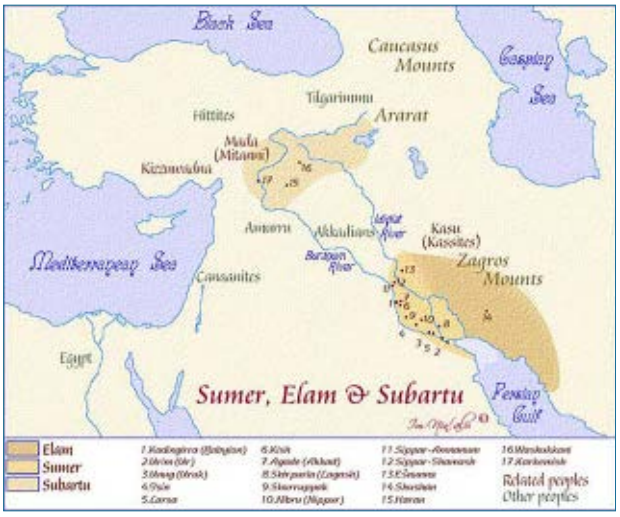

Image: imninalu.net

Figure 4. Map of Subartu

Image: Bjoertvedt / CC BY-SA 3.0, (modified)

Figure 5. Genesis 10 movements superimposed on Pre-Pottery Neolithic A distribution

Sargon's conquest of a northern 'Babylon'

Sargon of Akkad recorded his relocation of a city named 'Babylon' in the region of Diyarbakir, Turkey as part of his defeat of Subartu. He was one of the early empire builders, though we disagree with those who identify him as Nimrod.[15] In the ashes of Sargon's destruction of Ebla were found pottery with the cartouche of Pepi I of Egyptian Dynasty Six.[16,17] Given Pepi's place in the Memphite dynasties of Manetho, this places Sargon more than five centuries after the dispersion.

Sargon's home of Akkad is believed to have been in the region of Iraq near Babylon, and there is some evidence that Akkad was simply the original name for the city of Babylon. Sargon campaigned to the Mediteranean Sea and sacked the cities of Mari and Ebla *enroute*. He also made a campaign northward into a place called Subartu. There he claimed that he dug clay from the pit of Babylon and then made a new Babylon next to his city of Akkad in Lower Mesopotamia.[18] Thus Sargon claimed to have moved Babylon from Subartu to Akkad. Subartu was the region at the centre of the PPNA distribution, centred on the valley of the upper Tigris River. The modern city of Diyarbakir is situated near the centre of ancient Subartu (figure 4).

Clues from the biblical text

Three biblical texts speak to the location of Babel. These are the territories described in the Table of Nations (Genesis 10), the description of Babel itself (Genesis 11), and the description of Nimrod's first and second kingdoms (Genesis 10:10–12).

Territories of the Table of Nations

Genesis 10 describes the spreading out of the tribes after Babel, but it specifically describes the territories of one of the descendants of each of the three sons of Noah, as if these tribes were representatives of the larger group. The representative of Shem was Joktan, Ham is represented by Canaan, and Japheth by Javan. We know that not all the Japhethite tribes went west, and not all the Shemite tribes went East. This suggests that this list was made at a moment in time when Javan, Joktan, and Canaan were the first movers from their respective groups. The remainder of the tribes may have still been lingering in the central area before migrating out behind them. Another possibility is that the author of Genesis 10, living near Haran, only recorded the territories of tribes that were personally known to him.

If we compare the map of the PPNA to the territories of Genesis 10, we find that they match very closely (figure 5). The territory of Joktan was described as being "from Mesha toward Sephar, the great mountain of the East." We don't know for certain where Mesha or Sephar were located, though Mesha could be a reference to the Akkadian "Mashu" where the Ark landed. The eastward horn of the PPNA follows the Zagros Mountains toward Iran in the East. It is a better fit than any other information we have at this time. And incidentally, with a lower sea level, this also would have been on the way to the Eastern Arabian Peninsula where some Joktanite towns are believed to have been.[19]

Nimrod's two kingdoms

We learn from the Table of Nations in the 10th chapter of Genesis that Nimrod built four cities in the region of Babel

and then he "left that land" and built three or four more cities in Assyria.

> "Cush begot Nimrod; he began to be a mighty one on the earth. He was a mighty hunter before the Lord; therefore it is said, 'Like Nimrod the mighty hunter before the Lord.' And the beginning of his kingdom was Babel, Erech, Accad, and Calneh, in the land of Shinar. From that land he went to Assyria and built Nineveh, Rehoboth Ir, Calah, and Resen between Nineveh and Calah (that is the principal city)."

If we assume that Babel was the same city as Babylon then Nimrod's new cities in Assyria would have been upstream of Babel. However, the first clue that the conventional understanding of Babel in lower Mesopotamia might be wrong is that Nimrod's Assyrian cities are listed in order going downriver, not upriver.

Nineveh is the northernmost of the Assyrian cities, Calah is 30 km south, and Resen was between them. Rehoboth Ir has not been found. If the order of cities is a directional clue, then we should look for Babel in a plain once called Shinar that is upstream of Nineveh.

Of the five plains in Mesopotamia there are two that fit this description: Çınar (chee-nar) on the upper Tigris River near Diyarbakir, Turkey, and the Khabur Triangle of north-east Syria (figure 6). The name "Shinar" may have been applied to a large area of the land between the rivers, or several places. By the time of the Jewish captivity, which was at least 1,600 years after the Dispersion, Sumer was considered to be part of Shinar as well. (Daniel 1:2; Zechariah 5:11)

Genesis 10:10 tells us that Nimrod's first kingdom had four cities: "Babel, Erech, Accad, and Calneh".

In the plain where Babel was located, we should find three more ancient cities originally named Erech, Accad, and Calneh.

The Hebrew Shinar is pronounced "shee-nar". The name may not have survived to the present day, or it may only be found in parts of the region it originally described.

However, there is to this day a village and province in Turkey called "Çınar", pronounced "chee-nar", nearly identical to the Hebrew for Shinar. Figure 7 shows a detailed map of the

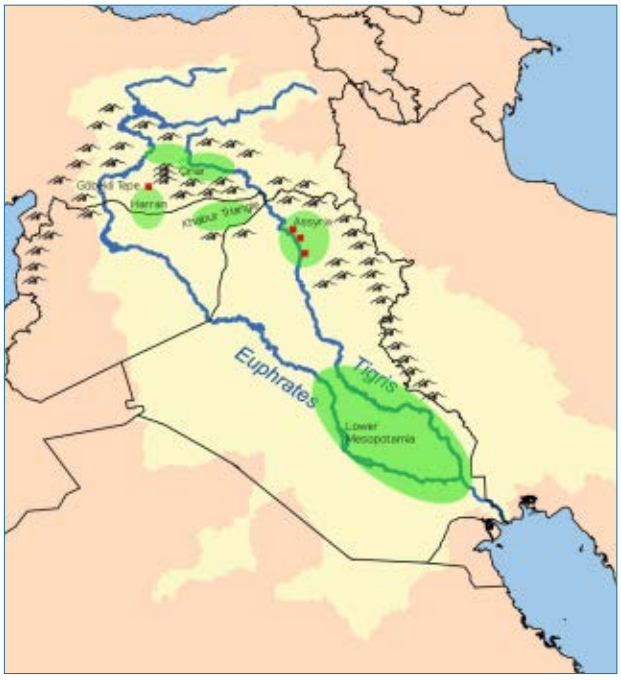

Image: Karl Musser / CC BY-SA 2.5, (modified)

Figure 6. The five fertile plains of Mesopotamia (WC modified by author)

Image: Google Earth (modified)

Figure 7. The region of Subartu in Upper Mesopotamia

Image: Google Earth (modified)

Figure 8. Proposed locations of cities of Nimrod's First Kingdom

Image: Google Earth

Figure 9. The mound of Kurkh, possible site of Nimrod's Erech.

region of Subartu in Upper Mesopotamia. Çınar is the fertile plain on the south side of the Tigris River. The name "Çınar" in Turkish and Persian means "plane tree". However, this region has been primarily inhabited from antiquity by non-Turkic tribes such as the Kurds, Armenians, and Assyrians. The region of Çınar today is not known for trees at all, but it is a flat plain and the richest agricultural land in Turkey.

As we zoom in on this region, we find that it meets all the criteria for Babel and Nimrod's first kingdom of four cities in the land of Shinar.

Here is a village and province called "Çınar" (chee-nar) which is located on a fertile plain bisected by the Tigris River. There are four ancient tels along the Tigris river, two of which appear to have retained some form of the original names until at least Neo-Assyrian times, and one of them until today. The preservation of one name alone would not be a very strong case. The preservation of three names, Shinar, Erech, and Calnah makes a much stronger case that this is the correct location. Figure 8 shows our candidate sites for the first kingdom of Nimrod in Çınar.

The name of Cain's first city was Enoch (Genesis 4:17). The name of Nimrod's second city, Erech, appears to be named after Enoch, as Uruk was also called Unug by the early Sumerians. Tiglath Pileser I (1076 BC) recorded his campaigns in this region, which he called Kirhi, near the mountain of Hiriki which is also the ancestral name of the mountain Karaca Dag.[19, 20] This word, Hiriki, appears to be derived from the biblical Erech. It was called Kurkh by Shalmaneser III several centuries after Tiglath Pileser I called it Hiriki. Nimrod's city of Erech may be the tel in Uctepe at 37°49'34.70"N, 40°32'21.80"E. Today the "Uc" in the name preserves the remnant of the original Erech. We would argue that about a century after the dispersion some of the residents of the original Erech followed the Tigris river to Sumeria, and built the city called Uruk.

We have an inscription from Ashurnasirpal II, the predecessor of Shalmaneser III, in which he describes cities in this valley that he conquered:

> "By the valley of Khulun, I entered the country of Kirkhi. I conquered the land of the Hittites, Khataru, Nistun, Irbidi, Mitkia, Arsania, Zila, Khalua, all Kirkhi cities, found between Usu mountains, Arua and Arardi. I have made a large number of slaves and I took their property. Their troops were frightened and retreated to a peak in front of the city of Nistun, which emerged from the sky like a cloud. ... Bubu son of Babua, the master of Nistun, in the town of Arbela, I revetted the walls with his skin."[21]

This inscription is notable because it seems to record three Bible names associated with Genesis 9 and 10: Khulun, Kirkhi, and Arardi would be Calnah, Erech, and Ararat or Urartu. Assyria contended for centuries with the city of Hattusa (the "Hittites") in Anatolia for control over the region between the Upper Tigris River and the western bend of the Euphrates. The fact that Ashurnasirpal calls this valley "the land of the Hittites" means that it had been under their control for some time prior to his campaign.[21]

The city "Khulun" that Ashurnasirpal mentions could be Nimrod's Calneh. He says he entered the region by the "valley of Khulun". If Ashurnasirpal followed the Tigris River up from Assyria, then Khulun/Calnah would be the first city encountered after emerging from the Tigris gorge onto the plain of Çınar.

Tentative sites for Nimrod's kingdom

We considered the following tentative sites for the four cities of Nimrod's first kingdom in Çınar.

Babel candidate sites:

a. Small structure under lava flow: 37°40'27.62"N, 40° 2'13.81"E
b. 600 x 1000 m rectangle canted 23° east of north: 37°44'57.88"N, 40° 6'30.17"E
c. Tel along old river terrace: 37°47'48.84"N, 40°22'45.39"E.

Erech:

The mound of Kurkh: 37°49'30.44"N, 40°32'26.63"E (figure 9).

Akkad, later called Tusshan:

a. 37°47'37.96"N, 40°47'30.28"E
b. 37°45'13.51"N, 40°55'24.03"E.

Calneh:

The last tel along the river before it enters the gorge: 37°47'54.18"N, 40°56'55.25"E.

Geological features

The Çınar region has a geological feature that could also explain the "terrible wind" that burned the Tower of Babel in the Book of Jubilees and other legendary sources. The mountain west of the site is Karaca Dag, an extinct shield volcano. However, there is one small cone on its eastern flank that erupted more recently. A lava flow believed to be in historical times flowed 20 km toward candidate site C and stopped about 10 km short (figure 10). If it was associated with a pyroclastic flow, which is a violent and scalding hot airborne current of ash, it certainly could have been perceived as "a burning wind" which gave an additional incentive for the people to flee the Babel project. We do not presently know when this eruption occurred, so the idea that it coincided with the dispersion is mere speculation until further studies can be made.

Figure 11 shows a 1998 map of oil and gas exploration in Turkey from the Turkish oil producer, Guney Yildizi Petrol Uretim. The Tigris River valley near Diyarbakir is the location of many oil and gas wells, indicating there was almost certainly a local source of tar bitumen there in the past.

Abraham two centuries after the dispersion

Another biblical clue is Abram's birth in Ur of the Chaldees, and his move to Haran with his father Terah. It seems to be universally accepted that Haran in Turkey was the Haran of Terah and Abraham. However, Leonard Woolley, a 'local flood' advocate and archaeologist who dug at Ur in the 1920's, popularized the Ur in lower Mesopotamia as the place where Abraham was born.

Cyrus Gordon later showed from the Mari and Ebla tablets that Urfa north of Haran was referred to as 'Ur Kasdim' which is Ur of the Chaldeans.[22] The Chaldeans may have migrated down the Euphrates in the centuries that followed, but in Abraham's time at least some of them were still in southern Turkey. It can be seen from the Assyrian annals that the Chaldeans did not start gaining control over Babylon until late in the Divided Kingdom era.[23]

Urfa and its closely associated Göbekli Tepe site are relatively near the centre of the PPNA culture. They are on the opposite side of the mountain Karaca Dag from Çınar. Following the Wiseman hypothesis that Genesis was written as a series of tablets by the witnesses to those events, we might conclude that Terah wrote the tablets for Genesis 10 and 11[24] and that his family was with the tribe of Arphaxad in the area today called Sanliurfa, formerly 'Urfa'. The name Arphaxad can be also represented as urfa-ksad(im), from which the name of the city 'Ur Kasdim' appears to be derived.[22]

Contrary to the consensus of scholars since the 19th century that Abraham was a contemporary of Hammurabi of the Middle Bronze Age, this would imply that Terah recorded his snapshot of the post-Babel territories toward the end of the PPNA period. This is not incompatible with the creationist stratigraphy of Osgood who places Abraham as a contemporary of the Ghassul culture in Palestine.[25] The Ghassul culture was in the transition from Neolithic to the Bronze Age in Palestine that is called 'Chalcolithic', which means they used a mixture of copper and stone tools.

Wood places the destruction of Sodom, when Abraham was 99, at the end of Early Bronze III.[26] Due to the conflicting claims of Wood and Collins we are unconvinced that anyone has identified Sodom with sufficient confidence to pinpoint the date of its destruction, much less to impose that date upon the life of Abraham.

In light of the 'mushroom' theory[27] that transitions of metal technology occurred at different places and cultures at different times, we might postulate that Terah wrote his account of the territorial division early in his lifetime at the close of the PPNA, possibly from a list made by his father, Nahor; while Abraham lived long enough to see the EBII in Southern Palestine. Given the 305 years that passed, and the 700 km of distance between the birth of Terah and the death of Abraham, there was sufficient time and distance for cultural transitions from the PPNA to EBII in the lifetimes of Terah and Abraham.

The behaviour of Nimrod might explain stark differences in metal technology between different groups in the Middle East in the centuries after the dispersion. The Bible states that Nimrod built Nineveh (Genesis 10:8–11). Diodorus quotes Ctesias that Ninus built the city Nineveh and named it after himself.[28] Beginning with Pseudo-Clement it was the opinion of the early church fathers that Ninus was Nimrod.[29]

According to Trogus Pompeius:

> "Ninus, king of the Assyrians, first of all changed the contented moderation of the ancient manners, incited by a new passion, the desire for conquest. He was the first who carried on war against his neighbours, and he conquered all nations from Assyria to Lydia, as they were as yet unacquainted with the art of war."[30]

It is interesting that the region that Pompeius says Ninus conquered corresponds exactly to the Taurus Mountains and the region of the PPNA. If Nimrod had confiscated all of the metals at the time of Babel and in his post-dispersion campaign to conquer Anatolia, then we might expect to see Hamitic cultures advanced in technology living next to now-impoverished Neolithic tribes of Shem and Japheth.

An Upper Mesopotamian Babel would also make sense of the battle of Chedorlaomer's forces against the kings of Sodom and Gomorrah. Chedorlaomer's coalition was composed of kings of Shinar, Ellasar, Elam, and Javan. The Hebrew word translated 'nations' for Tidal's kingdom is

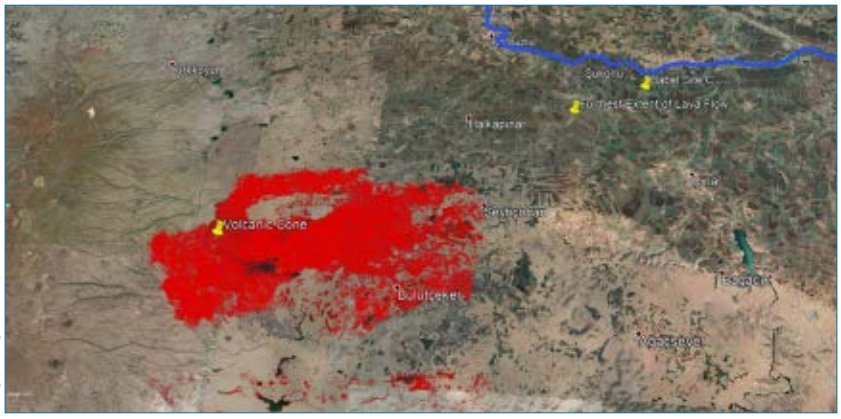

Image: Google Earth (modified)

Figure 10. Cone and lava flow (in red) near Babel site C

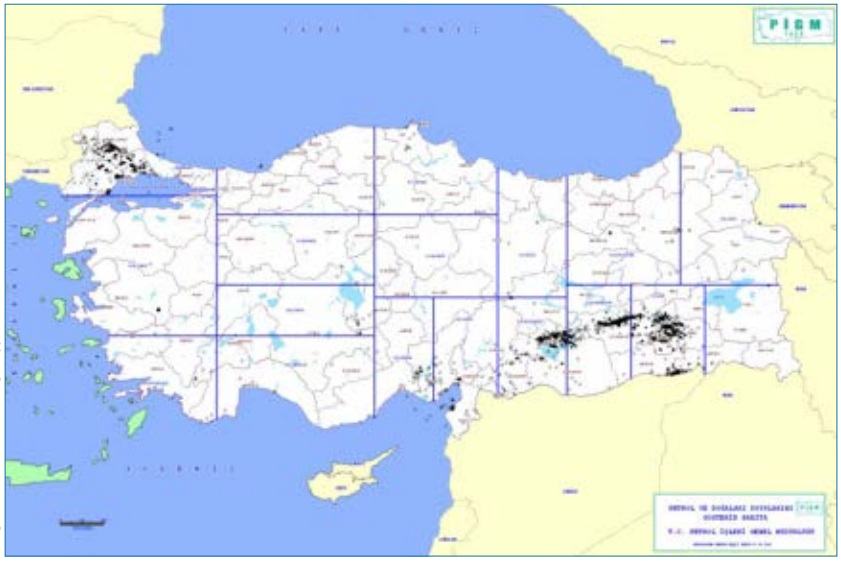

Image: PIGM & TPAO, www.guneyyildizi.com.tr

Figure 11. Oil and gas sites in Turkey

Goyim (Genesis 14:2, 9), which is the plural of the name Javan, which is also the source of the Greek word 'Ionia'. Elam and Ionia in later times were over 1,700 km apart. However, if Chedorlaomer's campaign occurred at the time of the transition from PPNA to the Chalcolithic, then all four of those tribes might have still been dwelling near each other in the region of Subartu. This is also seen by the fact that after their victory and after Abraham's night raid, they fled due north toward Haran, not east toward Sumer. This suggests that they came from the north.

The chronology and stratigraphy of Palestine and the ME was largely based on the 19th century assumption that Hammurabi was Amraphel, and therefore a contemporary of Abraham. That assumption has been known to be false since 1930.[31] If that is incorrect, then the chronology resulting from that assumption is also likely to be in error. Osgood proposed an alternate stratigraphic chronology in his paper "The Times of Abraham"[24] that supports our findings. He placed Abraham's time in Canaan in the Chalcolithic and the early Canaanite period down to the Exodus in the Early Bronze Age.

Site investigation

In November 2019 the authors took a small team to Diyarbakir, Turkey, and visited all three of the candidate sites for Babel, as well as the mound of Kurkh. We were able to rule out Babel candidate A as an extinct volcanic vent. We did not find any ceramics on the surface of candidate site B, but we cannot rule it out as a candidate for the tower itself without taking core samples.

Babel candidate site C turned out to be a classic tel with ceramics strewn around on the surface (figure 12). A short distance from the mound is a recent quarry, now a seasonal pond, dug since 2004 in an area where the topsoil appears to have been excavated in the past.

There are three ancient sources that say that Sargon dug dirt from the pit of Babylon and built a new Babylon opposite Akkad. We do not know if "the pit of Babylon" was a clay pit, or perhaps an ash pit beneath the altar of a shrine.

The tablet known as ABC 20 "The Chronicle of Early Kings"[32] relates Sargon's last campaign of conquest to Subartu as follows:

> "Afterwards, Subartu attacked Sargon in full force and called him to arms.
> Sargon set an ambush and completely defeated them.
> He overpowered their extensive army
> and sent their possessions into Akkad.
> He dug up the dirt of the pit of Babylon and
> made a counterpart of Babylon next to Agade."

Later interpreters gave a different version of the story in ABC 19, "The Weidner Chronicle":[29]

> "Sargon did not change but was careful to offer
> ... quickly to Esagila.

> Marduk, the king of the world, favored him and gave him the rule of the four corners of the world.
> He took care of Esagila. Everyone who sat on a throne brought his tribute to Babylon.
> Yet he ignored the command Bêl had given him. He dug soil from its pit
> and in front of Akkad he built a city which he named Babylon.
> Enlil changed the order he had given and from east to west people opposed him. He could not sleep.
> Naram-Sin destroyed the people of Babylon,
> so twice Marduk summoned the forces of Gutium against him.
> Marduk gave his kingship to the Gutian force."

The Weidner Chronicle and the Curse of Agade[17] both interpret Sargon's digging dirt from the pit of Babylon as being a sacrilege against the altar of the only Babylon they knew, whose temple was called the Esagila. That is the Babylon we know today, located south of Baghdad in Iraq.

However, we see a different solution to the puzzle. The Chronicle of Early Kings relates that Sargon dug dirt from Babylon and built a new Babylon near Akkad in the section describing how he looted and humiliated Subartu after defeating them.

All three of the candidate sites we have identified are located near the centre of Subartu.

Based on Sargon's correlation with Pepi I, Sargon reigned, at minimum, five centuries after the dispersion. We suspect that when he conquered Subartu, Sargon dug earth from beneath the altar of the shrine, and he 'made a new Babylon' which was a shrine to Bel Marduk just outside the walls of his city of Akkad. That new Babylon is the city known as Babylon today. Babylon has been determined to have been founded in the Akkadian era. Babylon, in our view, was Sargon's hometown of Akkad. However, the region of Akkad was overrun by the Guti barbarians a generation after the time of Naram Sin, the great-grandson of Sargon.

Centuries after Sargon's death, the legendary Semiramis II of Assyria is alleged to have ended the Arab Gutian dynasty by conquering the region of Akkad. She then allegedly upgraded the shrine village of Babylon and built walls around it.[9] The authors are aware that Semiramis II is unattested by archaeological records, as are most biblical characters. We would identify her as the wife of Tukulti-Ninurta I, who was the first Assyrian to conquer Babylon, and who began to reign around 1233 BC.

By the time that the Weidner Chronicle was written in the Neo-Babylonian Era after 606 BC, the original city with the Tower of Babel in Subartu had long been forgotten. Thus, the later priests of Babylon interpreted the story of Sargon digging dirt from the pit of Babylon as a sacrilege, which caused the gods to turn against Akkad and give them into the hands of the Guti barbarians.

However, the original text of ABC 20 makes it clear that Sargon was punishing Subartu by taking their shrine from the original Babylon and building a new one in Akkad. He carried away their belongings, their gods, and probably their priesthood.

We see a similar motive in the biblical account of Naaman the Syrian who, after being healed from leprosy by Jehovah, wanted to take two donkey loads of earth from Israel to his home so he could worship Jehovah (2 Kings 5:17).

Though they served radically different gods, the actions of both Namaan and Sargon can be viewed as taking 'holy ground' from the place where the deity was worshipped to another land in order to establish a new altar to the deity.

Given the ancient practice of building the ziggurat and temple to the god or goddess just outside the walls of the capital city, the upstart Sargon needed a cult for his capital of Akkad. He apparently decided that a cult to Bel Marduk, the first king of Babel, would set his city and empire apart from the others in Sumeria. Thus, we believe that he stole the cult of Marduk from the historic Babel in Subartu and built a new Babylon in Akkad. With time, Akkad eventually became known as Babylon, and the original Babel on the Çınar plain in the mountains of Subartu was forgotten.

Objections

The earliest fired bricks date from the Uruk period

Baked bricks older than the Uruk Period were found in level XIII at Tepe Gawra near the ancient site of Nineveh.[33] This is consistent with our hypothesis that Nimrod travelled down the Tigris River from the original Babel site building new cities. Due to their expense, the use of baked bricks even in much later eras was generally limited to monumental structures. We doubt that all four of Nimrod's first cities used fired bricks. These were most likely reserved for the temple and tower.

The mound is too small

Babel site C is a medium sized tel, only 276 m across, and about 16 m high, and it has no ziggurat. Large city temple complexes in lower Mesopotamia usually had the sacred precinct with the temple and ziggurat separated from the main city by a wall.

While commentators since Ussher have assumed that the dispersion occurred in the year Peleg was born, we find it more likely that Babel was a rebellion against the territorial division in the year Peleg was born, and was therefore begun

Figure 12. Babel site C with recent quarry

in the generation after Peleg and continued for at least one full generation until the dispersion. Thus, our estimate would be that the tower of Babel was constructed between the sixth and eighth generations, counting Shem as the first.

Using the average of 5.07 sons per generation found in Genesis 10, and assuming that Babel was begun the generation after Peleg and dispersed about 43 years later,[34] there may have been 3,000 adult men alive on Earth when the project began, and still fewer than 10,000 adult men at the dispersion.[35] With such a small workforce building both the tower and the city, gathering food, exploring the new world, and all the other economic activities, the original tower could not have been nearly as large as later ziggurats built with massive workforces.

It is feasible that the original city and tower of Babel lie below the mound at site C. Alternatively, the city could be site C, and the tower could be site B. After an initial abandonment, it is possible that the city site was re-settled and built upon until the Neo-Assyrian Era. Thus, we would expect somewhere between 1,000 and 1,500 years'-worth of occupation layers to be on top of the original city and temple, covering the original structures within a single mound.

Habermehl's Khabur Babel theory

Anne Habermehl[5] proposed that Babel and the other three cities of Nimrod were located in the Khabur Triangle of Syria adjacent to the Sinjar Mountains. She identifies Tel Brak as Babel. However, all four of the sites she has identified date from the Halafian culture, which is younger than the PPNA.

Quoting Habermehl:

> "There is one other thing that we need to look for, *and that is ruins that are the oldest on earth* (we assume here that all pre-Flood constructions were totally destroyed in the worldwide Flood). The subject of dating the Babel site can get quite confused if other means of dating are used, rather than the statements in the Genesis record [emphasis added]."

The fact that the PPNA is known to be older than the Halaf culture of the Khabur Triangle, by Habermehl's standard, suggests that the PPNA is where Babel should be found. No PPNA sites have been found in the Khabur Triangle.

Habermehl cites the Karnak Tablet as placing a region called "Saenkara", which she interprets as "Shinar", near Cappadocia. The plain of Çınar in Subartu on the upper Tigris in the ancient province of Sophene/Subartu/Shubari is immediately adjacent to the Cappadocia region of Anatolia, while the Khabur Triangle is separated from Cappadocia by the province of Commagene, which was called in the times of the Karnak Tablet, "Kutmuhe". Thutmose I campaigned as far as Shobat Enlil in the Khabur Triangle, but he referred to that place as "Amoru Nahrain" and "Mi-ta-ni".

As we noted above, the term Shinar, meaning "between the rivers" in Semitic, may have originally applied to the entire region between the Tigris and Euphrates. The region is currently called "Al Jazeera" in Arabic, which has a similar meaning, "the island". We find the name Çınar in Turkey, Sinjar in Syria, and later Ezekiel called Babylon a city in the "land of Shinar", indicating that Shinar was considered to be the entire region. Only a few places still preserve local instances of that name today. Babel was not necessarily in a region that still bears the name Shinar today.

We agree with Habermehl that Babel was located in Upper Mesopotamia, which is a rather large place. We disagree on her specific identification of the plain therein. Two of her strongest arguments for Khabur actually favour Çınar.

Conclusion—the site matches the parameters

The site we have identified as Babel site C matches the parameters we identified, save two:

- At the centre of the Pre-Pottery Neolithic A culture
- At the centre of the Genesis 10 territories
- Near the centre of the biological distribution of Neolithic founder crops
- On a plain called "Shinar"
- Nearby source of tar bitumen

- Near three more cities, two retaining same names from Nimrod's first set
- Upstream of Nineveh on the Tigris River
- Volcanic activity nearby.

Two parameters that we did not address in this paper are the requirements that the site have a kiln and fired bricks, and that Babel was on an east-west axis with the site of the Ark and altar of Noah. The first will require an archaeological excavation. The last remaining criterion is the subject of part two of this paper, which presents the case that the Ark site is located 50 km west of Babel site C.

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The systematic consistency of biblical creation: an introduction

Cody J. Guitard

In the realm of paradigmatic analysis, many tests have been proposed for selecting between one paradigm and another. One such test is the combinationalist test of systematic consistency, designed to evaluate the consistency of micromodels within a macromodel. Given the macromodel of Christian theism, the test of systematic consistency can be used to analyze the veracity of any proposed creation model (a micromodel within the macromodel of Christian theism) within that larger paradigm. It is argued that the standard formulation of the creation model commonly referred to as young-earth creationism (YEC) passes the three standard subtests of systematic consistency rooted in the rationalist, evidentialist, and experientialist schools of thought: logical consistency, empirical adequacy, and experiential relevance.

One of the central issues in science is the question of how to best put a given theory to the test to determine how well it corresponds to reality. Concerning the origins issue, the intramural debate among Christians is further complicated by the fact that we have both the scientific *and* the biblical data to take into account in our model building.A number of different creation models have been proposed to date whose respective proponents have generally professed to seek a consistent integration of the two sets of relevant data. (One notable exception is the religious myth view, which sees little to no historical value and, therefore, no scientific implications in the Genesis account.)

The pressing question is that of how to determine which creation model is correct, to which there have been a number of different approaches taken. It is not the purpose of this paper to advocate for any particular approach over another. (Indeed, it might be argued that each approach has its appropriate place in the origins debate.) Rather, for the sake of argument, we will assume an approach which evaluates a given model based on what has been referred to as systematic consistency. In doing so, this paper will provide some introductory notes on how this combinational or cumulative-case approach can be used to demonstrate the veracity of the standard formulation of the young-earth creation (YEC) model.[1]

The test of systematic consistency

One of the greatest issues in the evaluation of paradigms is the insufficiency of stand-alone tests. Whether it be rationalism, evidentialism, experientialism, or some other test for truth, a recurring problem is that each test only addresses—and, in many cases, only accepts—*one* feature of a more complex reality. The rationalist tends to be suspicious of personal experience. The experientialist tends to ignore any evidences which *undermine* personal experience. The evidentialist tends to forget that reason is required to interpret facts as evidence for one view or another. A combinational approach, however, betters the situation by incorporating each of these individual tests into a larger analytical scheme. Such an approach has sometimes been referred to as the test of systematic consistency.

While the test of systematic consistency is inadequate to test for truth *between* worldviews (e.g. between theism and atheism), it can rightly be used on a case-by-case basis for testing for truth *within* a worldview (e.g. between *Christian* theism and *Islamic* theism, between different views *within* Christian theism, etc.). Norman L. Geisler explains:

> "Once an overall framework has been determined, it follows that whatever most consistently and comprehensively fits into that system is true. If that system of truth is not only a worldview but a world and *life* view, then the applicability of that truth to life also becomes a crucial aspect of that truth. … *Systematic* consistency follows from the establishment of a system of truth. Or, to state it another way, once a macromodel is established for interpreting all the experiences and occurrences in the world, the most consistent and comprehensive way that the micromodels are fitted into it is the indication of truth. On the one hand, systematic consistency is inadequate to test *between* divergent systems since they all may be systematically consistent within themselves. But, on the other hand, systematic consistency is eminently qualified to test for truth *within* a system; that is what the system is all about. Anything not systematically related cannot be a truth within that system."[2]

For the purposes of this paper, we will presuppose a broad Christian theism as the worldview or macromodel accepted by all creation models. We will also assume that each model seeks a consistent integration of our respective understandings of God's world and God's Word. From that point of reference, we will begin to consider whether or not

the YEC model demonstrates a systematic consistency in its account of reality.

However, it must be remembered that the test of systematic consistency is a *probabilistic* test. That is, within the scope of the information presently available to us, the more tests a model passes, the more probable it is that the model corresponds to reality. If it appears to surpass other models in passing these tests, then it is more likely than those models to be true. As Geisler continues to explain:

> "It must be admitted that systematic consistency does not provide an apodictic or undeniable test for truth. For one thing, no finite mind is in actual possession of *all* the facts. Further, no finite person is able to comprehend completely *all the facts*. Also, finite minds have difficulty in understanding the consistency and inconsistency between all the facts. For these reasons, absolute certitude will be difficult, if not impossible, for every opposing truth claim made within a given worldview. As in almost everything else in life, probability is the guide. However, in some cases of high probability one may reach a level of moral certitude in which, while other views are logically possible, there are no known reasons to veto the acceptance of the truth claim being adopted.
>
> "In the case of systematic consistency within an established worldview, whichever conclusions *best* fit all the known facts and are the *most* consistent will be considered true."[3]

As we consider whether or not the YEC model demonstrates a systematic consistency in its account of reality, we are, in fact, evaluating its level of probability as being the *correct* creation model. The correct creation model *should* have full correspondence with both God's Word and God's world. We shall invoke the three standard subtests of systematic consistency rooted in the rationalist, evidentialist, and experientialist schools of thought. Respectively, we will invoke the tests of logical consistency, empirical adequacy, and experiential relevance.

The logical consistency of the YEC model

The first subtest of systematic consistency is that of *logical* consistency. This test follows one of the three laws of logic—that is, the law of non-contradiction, which says that A is not non-A. It is important that we take a moment to clarify what exactly constitutes a logical *in*consistency as this has been a point of confusion for many. As Morris R. Cohen and Ernest Nagel note:

> "One of the most fruitful sources of intellectual confusion is the too facile assumption that any two propositions which are not equivalent are mutually exclusive. Thus men have debated about the relation of mind to body, of heredity to environment, of selfishness to altruism, of art to nature, frequently without realizing that while the alternatives are not equivalent, it does not follow that they are mutually exclusive."[4]

Whether or not one agrees with every example Cohen and Nagel list is irrelevant to the point being made. Logical inconsistencies can at times be tricky to identify, which in turn leads to misidentifications. As we will see in a moment, this has certainly been the case in the evaluation of the internal consistency of the YEC model by its detractors.

Technically speaking, logical inconsistency encapsulates not only contradiction but also another closely related form of logical inconsistency called contrariety. Contrariety is often confused for contradiction, so clarification is in order. Two propositions *contradict* one another if the truth of one entails the falsity of the other and if the falsity of one entails the truth of the other. *Contrary* propositions are similar in that they cannot both be true. However, they differ from contradictories in that they *can* both be false. Contradiction and contrariety are, in fact, the only two forms of logical inconsistency. Therefore, if a set of propositions is to be determined as being false, one simply needs to identify at least one contradiction or contrariety within the set. On the other hand, if no contradiction or contrariety can be identified, then the set of propositions as a paradigm stands as a viable candidate for truth.

The simplest way to demonstrate the logical consistency of a view is to counter claims to the contrary. The charge of logical inconsistency is not a common objection raised against the YEC model. However, it does arise on occasion. Perhaps most popularly, it is supposed that the YEC model is logically inconsistent in its understanding of natural processes. On the one hand, the YEC model affirms that God has established a regularity in natural processes governed by natural laws (see Jeremiah 33:25). On the other hand, it

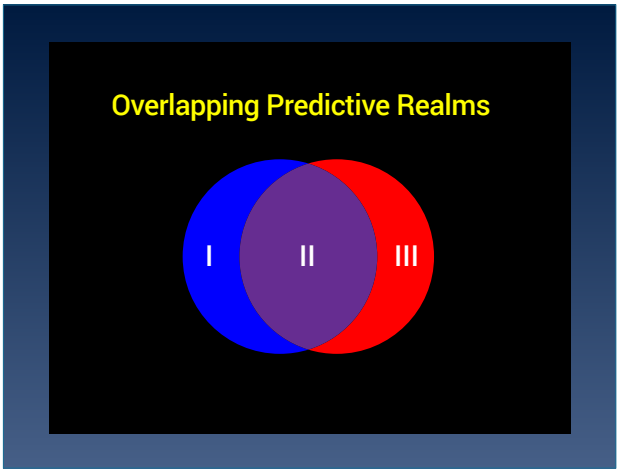

Figure 1. In the diagram, zones I and III each represent the predictive realm of a rival theory, while zone II represents the realm of predictive overlap between the two rival theories. Data which fall into the realm of predictive overlap cannot be used as evidence for either theory over the other.

accepts catastrophism, for example, as a viable framework for understanding the formation of the geologic record. Proponents of rival creation models have seen these as being logically contradictory propositions.[5] (This criticism aims to undermine the underlying principles of YEC scientists' advocacy of flood geology as well as their critique of deep-time dating methods.) However, the YEC position is not that physical *laws* change but that physical *processes* can change (including in their rate of change) as they are affected by external factors. In this case, there would only be a logical contradiction in the model if the two claims were universal propositions, which they are not. That is, in order for the two propositions to contradict, they would need to be formulated as something like "*All* geologic features were formed from *uniform* natural processes" and "*All* geologic features were formed from *catastrophic* natural processes". The former would be a strong form of uniformitarianism and the latter would be a strong form of catastrophism. However, the standard YEC model does not make such universal claims. Rather, the position set forth is more moderate. It consists of the two particular propositions "*Some* geologic features were formed from *uniform* natural processes" and "*Some* geologic features were formed from *catastrophic* natural processes".[6] It may not be a 50:50 ratio of uniform versus catastrophic causation, but the ratio is precisely the issue at hand. No scientist denies that both uniform and catastrophic processes play a role in shaping the earth. The YEC scientist simply grants a larger role to the catastrophic than do most other scientists.[7] What is *really* at issue, as far as the YEC model is concerned, is whether or not the Noahic Flood and its aftermath played a prominent role as the single most catastrophic geologic event in Earth's history in the formation of the geologic record. (Which is, of course, a question not of logical consistency but of empirical adequacy.)

Space does not permit us to explore further examples of alleged logical inconsistencies within the YEC model. However, the above example, which seems to be the most prominent one, serves well to show the YEC model's logical consistency.

The empirical adequacy of the YEC model

The second subtest of systematic consistency is that of empirical adequacy. The term was coined by philosopher Bas C. van Fraassen and, put simply, refers to the scientific accuracy of a theory. According to van Fraassen, a theory is judged to be empirically adequate "exactly if what it says about observable things and events in the world is true—exactly if it 'saves the phenomena'".[8] He elaborates:

> "To present a theory is to specify a family of structures, its models; and secondly, to specify certain parts of those models (the empirical substructures) as candidates for the direct representation of observable phenomena. The structures which can be described in experimental and measurement reports we can call appearances: the theory is empirically adequate if it has some model such that all appearances are isomorphic to empirical substructures of that model."[9]

Keep in mind, however, that raw data are subject to interpretation. As Stephen Jay Gould notes: "Facts do not 'speak for themselves'; they are read in the light of theory. … [Science is] not a mechanized, robotlike accumulation of objective information, leading by laws of logic to inescapable interpretation."[10] This is not to support the postmodern notions of relativism and of every interpretation being equally valid. Rather, we must carefully examine and determine which interpretation or account of reality is likely to be true.

When trying to assess whether or not a theory gives a true account of the world, scientists must weigh it against alternative theories by considering which theory can most consistently account for the relevant data.[11] Data which fall into the realm of predictive overlap between two rival theories cannot be used as evidence for either (figure 1). However, if certain data can only be accounted for by one theory and not the other, then this counts as evidence *for* the former and *against* the latter.

The YEC model can be demonstrated to be empirically adequate in two respects. First, its account of reality can consistently integrate the known scientific data within its paradigm. Second, it can account for data for which rival creation models cannot. Both criteria must be met in order for the model to be a competitive scientific model.

Observational consistency

On the first point of empirical adequacy, we can show that the YEC model's account of reality has not been discredited by the known relevant scientific data. To the contrary, it has proven to be able to consistently integrate into its paradigm what we are continuing to learn about the world around us and its record of the distant past.

A favourite example comes from the study of speciation. The YEC model, like many old-earth creation (OEC) models, predicts that there would be definitive boundaries between respective members of the originally created kinds (see Genesis 1:11–12, 21, 24–25; cf. 6:20, 7:14). These would include not only reproductive boundaries but also speciation boundaries (figure 2). As fate would have it, this is exactly what has been observed. Biochemist Michael Behe, who *accepts* the evolutionary tenet of universal common descent, points out that there are definite limits to what purely natural processes can account for in the origins of species. He places the boundary marker—"the tentative edge of evolution", as he calls it—at the taxonomic levels of genera, families, and/or orders.[12] These are the exact same taxonomic levels at which YEC scientists have identified the speciation boundaries of the created kinds.[13] (Modern taxonomy is a relatively recent man-made classification system. Therefore, it is no surprise that the respective speciation boundaries of the different

biblical kinds would fall along a small range of categories in this system.)

Another point of observational consistency, which came as a bit of a surprise, relates to the gradually decreasing lifespans evidenced in the chronogenealogies recorded in Genesis 11 and other Old Testament texts. YEC interpreters believe these chronogenealogies to list literal individuals and ages and to provide a complete timescale from the date of creation onward. In light of what is now known about biological decay due to genetic entropy, it has been observed that plotting the biblical pattern of decreasing lifespans reveals a very clear biological decay curve with a coefficient of determination of 0.96 (with 1.00 being a perfect fit) (see figure 3). Geneticist John C. Sanford comments on the discovery:

> "This unexpected pattern in the Biblical data is amazing. We are forced to conclude that the authors of the books of Genesis, Exodus, Joshua, and other books, either faithfully recorded an exponential decay of human life spans—or they collaborated in fabricating the data using sophisticated mathematical modeling. To fabricate this data would have required an advanced knowledge of mathematics, as well as a strong desire to show exponential decay. But without knowledge of genetics (discovered in the 19th century), or mutation (discovered in the 20th century), why would these authors have wanted to show a biological decay curve? It does not seem reasonable to attribute this [*sic*] data to some elaborate fraud thousands of years ago. The most rational conclusion is that the data are real, and that human life expectancy was once hundreds of years but has progressively declined to current values. The most obvious explanation for such declining life spans, in light of all the above discussions, would be genetic degeneration due to mutation accumulation."[14]

These examples of observational consistency from the areas of speciation and biological decay show that the YEC model has received expected *and* unexpected scientific confirmation.

Some will no doubt contest that there have been some scientific data (e.g. radiometric dating, distant starlight, allegedly transitional fossils, etc.) that appear to conflict with the YEC model. However, such data have been met with thoughtful responses from the YEC scientific community. Plausible explanations have been given for the apparent discrepancies between the YEC model's account of the observed phenomena and the phenomena themselves. Some of the apparent discrepancies, for example, have been issues of interpretation. (Recall my earlier comments on the interpretation of scientific data.) Alleged evolutionary transitional forms in the fossil record are a case in point. According to evolutionary models of origins, these are supposed to bridge the gaps between what YEC scientists have identified as the boundaries of speciation (i.e. the boundaries of the created kinds). However, most alleged transitional forms are based on scant fossil fragments and artistic impressions. Others might just as easily be interpreted as members of a particular created kind. On the ambiguity of interpreting the fossil data on this matter, evolutionist paleontologist Colin Patterson rightly notes: "Fossils may tell us many things, but one thing they can never disclose is whether they were ancestors of anything else."[15] Another example would be the reality of physiological and genetic similarities between members of what the YEC model would classify as different created kinds. While these similarities certainly could be interpreted as evidence of evolutionary relatedness or common *ancestry*, they could be *at least* as easily (and arguably *better*) interpreted as evidence of common *design*.[16]

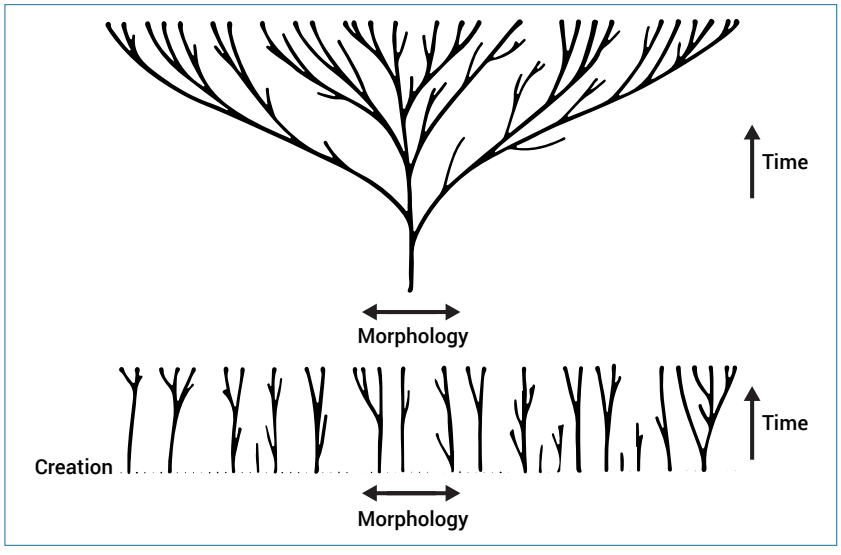

Figure 2. Contrary to the assumption of universal common ancestry illustrated in the evolutionary tree of life (top diagram), the YEC model predicts that there would be definitive boundaries between respective members of the originally created kinds (bottom diagram).

Other apparent discrepancies between the YEC model and the empirical data have been issues not of *interpretation* but of pragmatic *assumptions*. This has been true, for example, in the case of deep-time dating methods. Put broadly, each method assumes three principles: (1) initial measurements are known; (2) the system is and always has been closed; and (3) the rate of change has always remained constant. However, YEC scientists have set forth a number of reasons as to why these assumptions appear to be false. Consider the various radiometric dating methods, which are the most popular of the deep-time dating methods. Over the years, there has

been mounting evidence that one or more of the underlying assumptions listed above are false with respect to radiometric dating, though which particular ones prove false may differ between types of samples and isotopic decay processes.[17] Some studies, for example, have suggested that some radiometric decay rates may change in relation to the earth-sun distance at different points in the year.[18] This does not appear to be true for all radiometric decays, but it seems to be true for at least some, highlighting the fact that "different nuclides have different sensitivities to whatever external influences are responsible for the observed periodic variations".[19] In other words, it would seem that different external influences affect different radiometric decay rates to varying degrees. What is more, while some radiometric decay rates may change with the earth-sun distance, others may not while at the same time being affected by other external factors like chemical environment[20] or geomagnetic activity.[21] This means that at least one of the assumptions underlying radiometric dating methods is false in at least some and possibly all cases. It is only a matter of identifying precisely what external influences affect which particular decay processes. Thus, radiometric dating methods might not pose the threat to the YEC model that advocates of deep time might think.

Reasonable explanations have also been proposed for other apparent discrepancies between the YEC model and the empirical data. Has there always been a consensus among YEC scientists as to how to best explain each and every difficulty? Of course not. Are there still some unanswered questions and a lack of plausible explanations when it comes to how the YEC model might account for certain phenomena? Certainly. But such is the case with any scientific model, and this is a far cry from being *inconsistent* with the data. In reality, the only real inconsistencies that have arisen to date have been between the YEC model's account of reality and the phenomenological *interpretations* and *assumptions* formulated by proponents of rival origins models. Thus, the YEC model's claim to observational consistency—the first point of empirical adequacy—remains standing.

Unique explanatory power

There is a second point of empirical adequacy that sets the YEC model apart from other creation models in the minds of its adherents in the scientific community. In addition to its ongoing consistency with the relevant scientific data, it also has unique explanatory power, being able to account for data for which rival creation models apparently cannot.

An excellent example comes from the question of human origins. The YEC model predicts that all human beings past, present, and future should be traceable back to an original pair of progenitors—Adam and Eve. To be sure, this view is shared with some of the other creation models. However, what is unique to the YEC model's prediction is the supposition that this first human pair would have lived only about 6,000 years ago. This stands in contrast to a date of tens or hundreds of thousands of years ago, as per old-earth or evolutionary creation models which affirm a historical Adam and Eve.[22] The latter dating of Adam and Eve comes from evolutionary models for interpreting female-specific and male-specific sections of DNA (mitochondrial DNA and Y-chromosomal DNA, respectively) based on the assumptions of slow mutation rates and of common ancestry with primates. However, the *assumption* of common ancestry begs the question of human origins, and the slow mutation rates are hypotheticals presumed by the evolutionary models. As evolutionary geneticist Erika Hagelberg notes concerning the so-called 'Mitochondrial Eve' in particular, using real-world mutation rates yields a very different date for Eve:

> "mtDNA datasets often exhibit anomalous patterns. One of these anomalies is the discrepancy between mtDNA mutation rates observed in evolutionary timescales (e.g. in dating the divergence between two species) and those measured within family pedigrees. If the high mutation rates seen in some human pedigrees were used to calculate the age of our most-recent female common ancestor, she would have lived just 6000 years ago, a date more consistent with Biblical Eve than Mitochondrial Eve."[23]

Of course, Hagelberg and other evolutionists reject this recalibration of the mitochondrial clock as it does not fit their human origins model. However, such a recalibration seems perfectly reasonable as it would be based on actual *observed* data rather than *hypotheticals* rooted in evolutionary assumptions. The new date for 'the mother of all living' would not only be *exclusively consistent* with the YEC model's understanding of human origins but would also be *predicted* by that model and that model alone. The same holds true for Y-chromosomal mutation rates and tagging a date to the *father* of all living.[24]

Additional examples could be given to demonstrate the unique explanatory power of the YEC model. However, those given above, combined with the model's observational consistency, should be sufficient to highlight the YEC model's empirical adequacy.

The experiential relevance of the YEC model

The third subtest of systematic consistency is that of experiential relevance. That is, for a paradigm to be true, it must be sustained in our human experience. Of the three subtests discussed in this paper, that of experiential relevance tends to be the most difficult to demonstrate. This is because experience, while real, is often privatized and interpreted subjectively. This in turn leads to conflicts between personal experiences—or, really, conflicts between *interpretations* of these experiences. To overcome this difficulty, we will simply draw on what appears to be a public or universal aspect of the human experience as our example. We will then suggest

why it seems to be best explained within the YEC model of origins.

The greatest point of experiential relevance for the YEC model is its explanation for the problem of evil. The model maintains that God's original creation was free from pain, suffering, and death. Such things are consequences of sin's entrance into the world at the fall of man. Everyone who takes a look at the world today recognizes that something has gone terribly wrong—that things are not the way they are supposed to be. The evolutionary account of history would tell us that all the pain, suffering, and death in the world are perfectly natural and are, in fact, a necessary part of the evolutionary process. However, without being instructed in this way of thinking, people have a deep-seated inner sense that things are *not* supposed to be this way.

The YEC model affirms this inner sense and offers a satisfactory explanation for its validity: things are *not* the way they are supposed to be because the originally very good creation free from pain, suffering, and death has been lost. However, the Bible also offers the good news that we will one day see the heavens and the earth restored to their originally very good state free from sin and all its consequences. As Randy Alcorn notes:

> "God has never given up on his original creation. Yet somehow we've managed to overlook an entire biblical vocabulary that makes this point clear. *Reconcile. Redeem. Restore. Recover. Return. Renew. Regenerate. Resurrect.* Each of these biblical words begins with the *re-* prefix, suggesting a return to an original condition that was ruined or lost. …"
>
> "These words emphasize that God always sees us in light of what he intended us to be, and he always seeks to *restore us* to that design. Likewise, he sees the earth in terms of what he intended it to be, and he seeks to restore it to its original design."[25]

Albert M. Wolters presses the point further:

> "All these terms [with the *re-* prefix or equivalent] suggest a restoration of some good thing that was spoiled or lost.
>
> "Acknowledging this scriptural emphasis, theologians have sometimes spoken of salvation as 're-creation'—not to imply that God scraps his earlier creation and in Jesus Christ makes a new one, but rather to suggest that he hangs on to his fallen original creation and *salvages* it. He refuses to abandon the work of his hands—in fact he sacrifices his own Son to save his original project. Humankind, which has botched its original mandate and the whole creation along with it, is given another chance in Christ; we are reinstated as God's managers on earth. The original good creation is to be restored."[26]

But a return to the original creation is only good news *if* the original creation was indeed free from pain, suffering, and death to begin with—a tenet which only the YEC model maintains. The YEC model affirms the inner longing for a better world as the experiential echo of the better world that was once lost but will be regained. The Bible says that eternity is written on our hearts (Ecclesiastes 3:11) and the YEC model provides a framework for an eternity worth longing for. This is the ultimate point of experiential relevance for the YEC model.

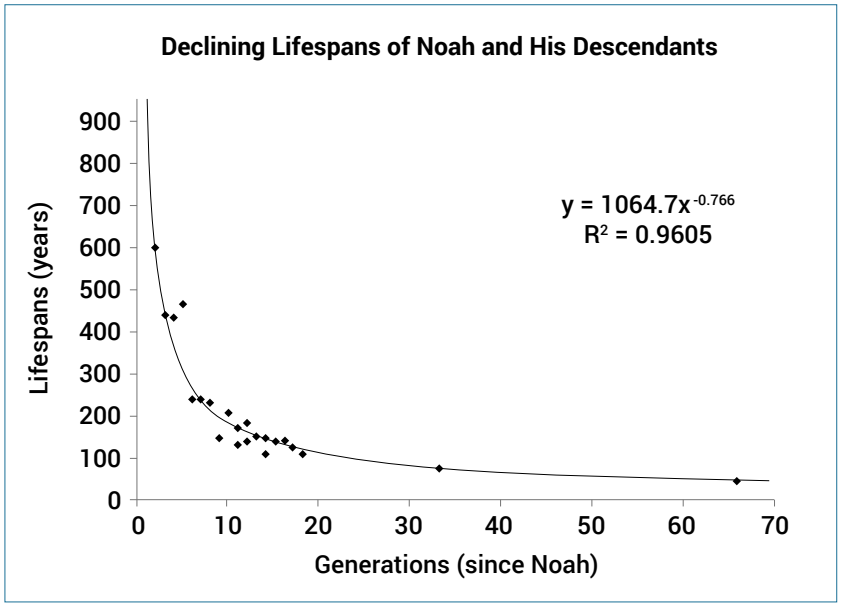

Figure 3. Plotting the biblical pattern of decreasing lifespans reveals a very clear biological decay curve with a coefficient of determination of 0.96 (with 1.00 being a perfect fit) (from Sanford[14], p. 168).

Conclusion

Further examples and discussion could be provided to demonstrate the veracity of the YEC model in each of the subtests of systematic consistency. However, while our application of these tests has been necessarily brief, the examples provided for each subtest highlight the YEC model's ability to pass these tests. At the same time, this serves as a case study to show how such an analysis could likewise be applied to alternative creation models. Again, it is important to remember that this is but one approach to testing the truth of a creation model. Furthermore, additional subtests could (and should)

be incorporated into the overarching scheme of systematic consistency. (One such test would be a test of biblical consistency.) After all, the more tests a model passes, the more likely it is that it is the correct representation of reality. Regardless, even the brief testing to which we have subjected the YEC model in this paper exemplifies the logical consistency, empirical adequacy, and experiential relevance of the YEC model. This provides corroboration (though not definitive proof) for the view that this model is, in fact, a true account of reality and, therefore, the correct creation model, being in full correspondence with both God's Word and God's world.

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Doppelgänger protein 'Signal Recognition Particle 14' refutes evolution

Matthew Cserhati

Evolution has difficulty explaining the similarities in gene distribution and sequences in unrelated groups of organisms. Doppelganger genes are genes that are highly homologous to one another but are found on disjunct parts of the alleged evolutionary tree. One such doppelganger gene codes for a protein called the Signal Recognition Particle 14 (SRP14), which has a poly-alanine C-terminus. This protein is known to occur in most species of the primate apobaramin, but also in a species of bat, called the little brown bat. Another SRP14 isoform without a poly-alanine C-terminus also occurs not only in this bat species but also in primates, rodents, protists, and yeast. Evolution cannot explain why this isoform is conserved throughout the alleged evolutionary tree, yet two structurally significantly different isoforms occur in one species. Creation theory offers a better explanation, namely that these two SRP14 isoforms are distinctly created functional units.

The distribution of genes and their sequential similarities and differences challenge evolutionary theory. For example, the gradual transformation of one family of genes to another has never been observed, indeed it cannot even be observed. The *de novo* appearance of genes from random non-coding sequence has also never been observed. Evolutionary conservation of genes is also an oxymoron—how can proteins manage to evolve by staying the same for millions of years?[1]

Doppelganger genes perform the same function and have highly similar structures, appearing in two distinct clades far from one another on the alleged evolutionary tree.[2] For example, the gene which codes the protein prestin, which plays a role in echolocation, is expressed in the inner ear of whales and bats.[3] While it is broadly present in a number of vertebrate animals, it is also present in species of Ascomycetes as well as *Blastocystis*. This latter group of heterokont parasites belongs to a larger group called Stramenopiles, which includes organisms such as algae, diatoms, and water moulds.

Besides their structural similarity, doppelganger genes also show sequential similarity with one another. In contrast, analogous genes are found in unrelated organisms, and have the same function, albeit with totally different structures. They are thought to arise via convergent evolution, although it is difficult to understand how completely different sequences can give shape to the same structure.

Doppelganger genes pose a serious problem to evolutionary theory. The same, or very similar, sequences of mutations would have had to occur in different DNA sequences in two different branches of the evolutionary tree to produce two genes that are very homologous to one another. To explain this, evolutionists allege that the same kind of gene once existed in all of the organisms leading from the common ancestor of the two clades all the way up to the two clades themselves. Afterwards, all of these genes were lost in the intermediate species connecting the two clades during several rounds of massive gene deletion.

The probabilities of these events occurring are extremely low. A much simpler explanation is that these genes are created functional units which already existed in disjunct clades; that is, baramins. These proteins differ according to the cellular context they function in.

The signal recognition particle complex

The cell produces several proteins, which fulfil their function in the endoplasmic reticulum (ER) or the thylakoid membrane in bacteria. These proteins contain a hydrophobic signal sequence at their N-terminus which tells the signal recognition particle (SRP) complex to translocate them into the ER. The SRP complex is a cytoplasmic ribonucleoprotein—a multi-unit macromolecule made up of proteins and RNA. The different components of the SRP complex are shown in figure 1.

The SRP consists of two domains, the S domain and the *Alu* domain. The S domain, consisting of SRP19, 54, 68, and 72, is responsible for binding the nascent signal sequence by SRP54 as it arises from the ribosome. This process is called 'elongation arrest'.

The S domain is connected to the *Alu* domain by the SRP RNA. The *Alu* domain is responsible for the elongation of proteins once they exit the ribosome and consists of the proteins SRP9 and 14.[4] SRP14 has a very interesting distribution in living organisms, which classifies its encoding gene as a doppelganger gene.

Conservation and distribution of SRP14 contradicts evolution

The proteins in the SRP occur in primates, bats, rodents, yeast, and even protists such as *Plasmodium falciparum*.[5]

Even though there are structural differences within different groups, they perform the same function.[6] The *Alu* RNA structure of the Archaean *Pyrococcus horikoshii* is so similar to that of human that even the human SRP9/14 heterodimer can bind to it.[7] Interestingly, the yeast SRP has no SRP9 homologue, yet still shows elongation arrest which is dependent upon two Srp14p proteins which substitute SRP9. Furthermore, yeast also contains the protein Srp21p which has no known homologues in other organisms.[8,9]

SRP9/14 homologues are absent in Archaea and Eubacteria. However, Nakamura *et al*. think that the histone-like protein HBsu from *Bacillus subtilis* is a functional analogue in Eubacteria. In *B. subtilis*, this protein binds the *Alu* domain of the scRNA, which plays a role in membrane docking, the lack of which leads to depletion of extracellular enzymes.[10]

Since the structure and function of SRP14 is so conserved in very different organisms, their very existence is evidence of non-evolutionary stasis. Furthermore, the existence of functional SRP14 analogues in prokaryotes contradicts sequential transition between prokaryotes and eukaryotes.[11]

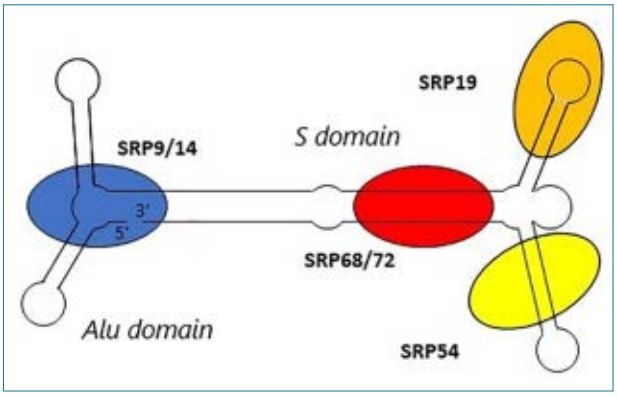

Figure 1. The Signal Recognition Particle. The S domain on the right is responsible for elongation arrest of the nascent protein in the ribosome. The *Alu* domain on the left is responsible for protein elongation once bound by SRP54.

Comparison between primates and bats

Interestingly, in primates, the SRP14 protein contains a 16-amino-acid–long segment containing 15 alanines: $A_9PA_4TA_2$ in its C-terminus. This poly-alanine tract could be due to the expansion of the trinucleotide GCA, with the G mutating to A or C to get threonine (T) or proline (P). However, the presence of the poly-alanine C-terminus does not confer any differential RNA-binding onto SRP14, although this may not be important.[12] The poly-alanine C-terminus is absent in some primates, such as *Carlito syrichta* (the Philippine tarsier, XP_008068029.1) and *Microcebus murinus* (the Gray mouse lemur, XP_012621845.1).

Among bats, the only known SRP14 protein that contains a poly-alanine C-terminus is found in *Myotis lucifugus*, the little brown bat (G1PG47_MYOLU). In *M. lucifugus*, the poly-alanine C-terminus is somewhat different than in primates, with a sequence of A_2GA_9. Nevertheless, both primates and *M. lucifugus* share a stretch of nine alanines in their C-terminus. An alignment of 11 SRP14 proteins from four primate and six bat species is shown in figure 2. The identity matrix comparing the sequence similarity between these 11 SRP14 proteins as well as the proteins' accession

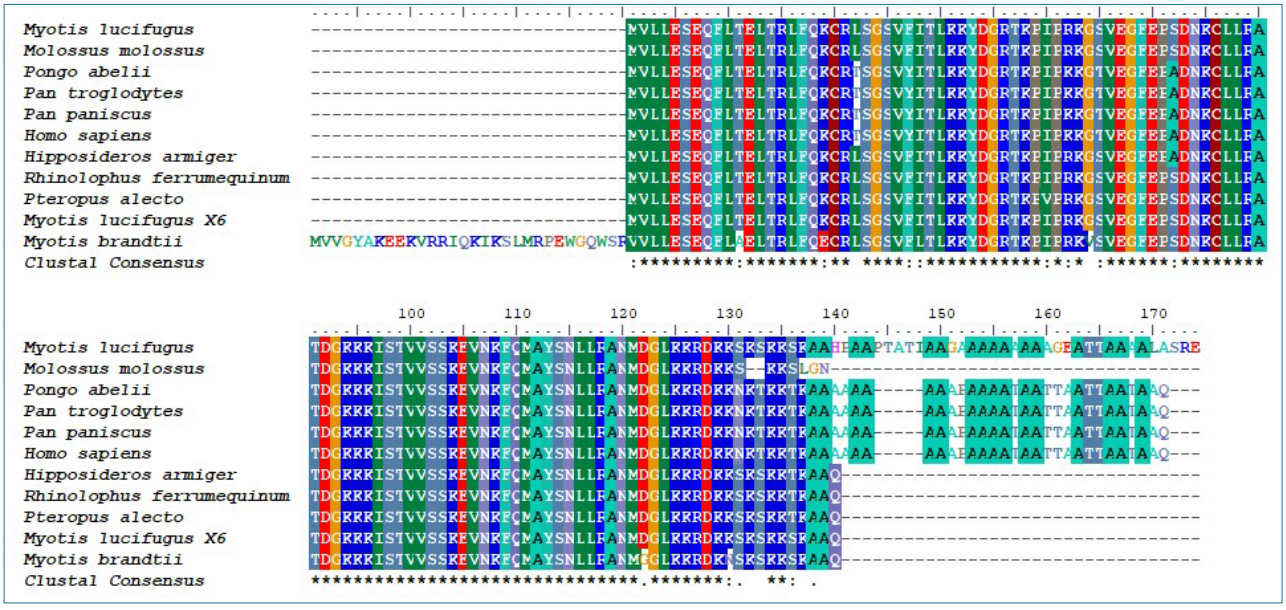

Figure 2. Multiple alignment of 11 SRP14 proteins using ClustalW. SRP14 has two basic isoforms, one with and one without a poly-alanine C-terminus, mainly in primates and bats, respectively.

Figure 3. Secondary structure sequence of three SRP14 proteins. H = alpha-helix, T = turn, E = beta-sheet, C = coiled coil, hSRP14 = human SRP14, MISRP14 = *Myotis lucifugus* SRP14, RfSRP14 = *Rhinolophus ferrumequinuum* SRP14.

numbers are found in supplementary file 1 (see 'Materials and methods' section below).

Even more interestingly, *M. lucifugus* has an X6 isoform of the SRP14 protein (XP_006093069.1), which is at least 98% similar in its sequence to the SRP14 protein found in three other bat species: *Hipposideros armiger*, *Pteropus alecto*, and *Rhinolophus ferrumequinuum*. In comparison, its other SRP14 isoform is only 74.3–75% similar to the SRP14 proteins in these three species.

The obvious question is, how did such sequentially different variants of the same gene arise in *M. lucifugus*? Does evolution really say that this one sequence underwent significant change in the life of this one bat species? It makes much more sense to view both the regular and the X6 isoforms of the SRP14 genes as separately created functional units. It is as if God directly created a poly-alanine SRP14 protein isoform in *M. lucifugus* to defy evolution.

Comparison of secondary structure

Figure 3 shows a secondary structure plot for three SRP14 proteins from human, *M. lucifugus*, and *R. ferrumequinuum*. H stands for an amino acid which is a part of an alpha-helix, E for a beta-sheet amino acid, C for a coiled coil amino acid, and T for a turn amino acid. Interestingly, all three proteins contain an 11-amino-acid-long structure TTTEEEEEECC, which corresponds to the protein motif GKKKISTVVSS, from positions 63 to 74. Both bat proteins contain the secondary structure TTTTTCEEEEETTTTTTCEEECTTCCCEETCTTTT, from positions 19 to 54. However, *M. lucifugus* SRP14 is more similar to human SRP14 in its alpha-helix C-terminus, as well as its overall length, not to mention the poly-alanine segment discussed earlier.

Baraminic relationships based on SRP14 sequence identities

A sequence identity matrix was derived from the alignment of the 11 SRP14 proteins in figure 2. This matrix was then displayed in the heatmap shown in figure 4. The Hopkins statistic is 0.641, which indicates fair clusterability. This way, baraminic relationships can be visualized based on sequential similarities. The caveat is that since this baraminogram is based on the sequence identity matrix of a single protein, we cannot draw strong conclusions from these results.

There are four clusters, two large ones and two singleton species. Both larger groups are statistically significant, with a p-value of 2.4×10^{-4} for the poly-alanine C-terminus isoform in the primate apobaramin, and 9.3×10^{-18} for the other isoform in the bat apobaramin (see 'stats' tab in supplementary file 1). A silhouette plot also shows that there are four optimal clusters (supplementary figure 1). The maximum silhouette value is 0.756, which indicates statistically significant clusters.

These four SRP14-based clusters centre around two basic SRP14 isoforms, the poly-alanine isoform present in the primate apobaramin, as well as the non–poly-alanine isoform present mainly in the bat apobaramin. The *Myotis brandtii* SRP14 (EPQ10995.1) differs from the other bat non–poly-alanine protein isoforms sequences due to a 30-amino-acid leader sequence in the N-terminus which is absent in the other protein sequences.

Discussion and conclusion

The distribution and sequence similarities of the SRP14 protein in the SRP complex are a thorny riddle for evolution. Its conserved structure and function in organisms from yeast to human defy evolution because evolution is change, not stasis. Furthermore, analogous proteins in archaea and bacteria contradict gradual sequential variation in this protein over time.

Besides this, the presence of the poly-alanine C-terminus isoform of SRP14 in primates and *M. lucifugus* is difficult for evolution to resolve. Since bats and primates are disjunct clades (apobaramins), it is hard to explain how the same protein could even arise through random mutations in lineages leading up to these two groups. This classifies SRP14 as a doppelganger gene. Furthermore, *M. lucifugus* has two different SRP14 isoforms, each with a significantly different structure. How evolution posits significant sequential changes within a single species, but also that the SRP14

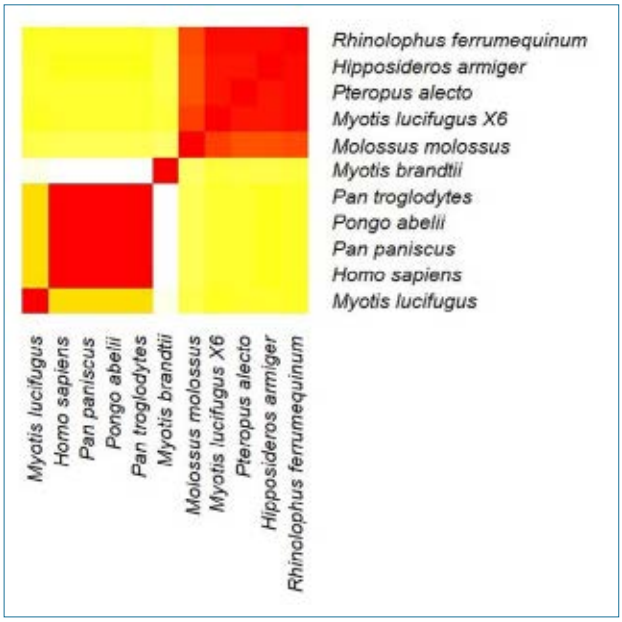

Figure 4. Heatmap representing the sequence identity matrix of the 11 SRP14 proteins in the multiple alignment of figure 2. Bright red colours correspond to sequence identity values close to 1, whereas yellow colours denote identity values closer to 0. Two main groups are visible, one for the poly-alanine C-terminus SRP14 isoform in primates and *M. lucifugus*, and the other for the non-poly-alanine C-terminus in the other bat species.

protein is conserved all throughout the evolutionary tree, is difficult to understand.

Creation theory offers a much simpler explanation without forcing the data into an evolutionary tree. Rather, different protein isoforms, such as those seen in SRP14, can be seen as discrete functional units created within individual species or baramins.

Materials and methods

All protein sequences were downloaded from the National Center for Biotechnology Information (NCBI) database. Secondary protein structures were generated for the three SRP14 proteins in figure 4 using the 'garnier' program from the EMBOSS bioinformatics software suite at bioinformatics.nl/cgi-bin/emboss/garnier.[13] The heatmap was constructed using the 'heatmap' command in R version 4.0.3. The clustering method was set to 'ward.D2'.

Construction of Hidden Markov Model

A Hidden Markov Model (HMM) was constructed using the 'hmmbuild' command on an alignment of ten primate SRP14 proteins. The accession numbers of these proteins are listed in supplementary file 2. The software used to construct the HMM was downloaded from hmmer.org. Using an HMM is a more sensitive way of finding homologous proteins than BLAST[14] This HMM and supplementary files 1 and 2 are available at github.com/csmatyi/SRP14. The SRP14 HMM was then used to locate bat protein sequences at the HMM search website at ebi.ac.uk/Tools/hmmer/search/hmmsearch, using default parameters, with the Organism option set to 'Chiroptera'.[15]

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The 'waters above' do not surround all galaxies: a critique of the 'cosmic shell' interpretation of Genesis 1:6–8

Keaton Halley

Many creationists believe that the waters God placed "above the expanse" on the second day of Creation Week depict waters surrounding the entire universe. But this 'cosmic shell' view faces several exegetical difficulties. Three problems are outlined, leading to a recommendation that the cosmic shell view be reconsidered.

Among Bible interpreters, there is a notable lack of consensus regarding the identity of "the waters that were above the expanse", which God separated from "the waters that were under the expanse" on Day 2 of Creation Week (Genesis 1:7). In the Genesis account, the waters below are later given the name "Seas" (Genesis 1:10), but God does not name the waters above. To what do they refer? Many views have been offered, but most Bible readers subscribe to one of four positions which can be summarized using the following shorthand names: (1) a pre-Flood canopy, (2) a vaulted sea, (3) clouds, and (4) a cosmic shell.

In creationist circles, it was once popular to believe the first view—that the earth was originally surrounded by a vapour canopy which collapsed at the time of Noah's Flood to produce its 40 days and nights of rain. This theory has fallen out of favour due to its numerous biblical and scientific problems.[1,2] Creationists also rightly reject the second view, held by liberal scholars, that the biblical authors conceived of the waters above as a liquid ocean suspended over a flat earth, held back by a solid vault in the sky. This perspective is inconsistent with inerrancy, and it also has serious exegetical problems.[3] My own view is that the waters above refer to clouds. This view will not be defended here other than indirectly by way of critiquing the fourth proposal—that the waters above refer to a shell of ice fragments or liquid water surrounding the entire universe. Though the cosmic shell view has become popular among contemporary creationists, it faces several challenges that require attention.

A summary of the cosmic shell view

While a form of the cosmic shell idea was advocated long ago by such historical figures as Martin Luther (figure 1), its modern incarnation was developed and popularized by creationist physicist Russell Humphreys.[4] Similar views have been espoused by Faulkner and Mortenson.[5,6] In Humphreys' model, on Day 1 God initially created a giant sphere of liquid water which included the inchoate earth. The sphere is equated with the primordial 'deep' of Genesis 1:2 and its surface was "the face of the deep" over which the spirit of God hovered. On Day 2, God allegedly split this sphere into a much smaller inner sphere and a larger outer shell of water, leaving empty space in between. The inner sphere was to undergo further changes during Creation Week to become more like the earth as we know it, with its now familiar dry land, oceans, plants, and animals. Meanwhile, Humphreys proposed, God pushed the upper shell of 'waters above' outward so that the 'expanse' (*raqiya'*) between the two bodies of water quickly grew to envelop all of what would become "interstellar space".[7] As the shell of upper waters rapidly receded from proto-Earth, it thinned to form a spherical halo (or cosmic shell) surrounding the entire universe, quickly reaching a size of at least 24 billion light-years in diameter.[8] This shell need not have remained in a liquid state or as one contiguous body, according to Humphreys. He says that it may now be in the form of "a tenuous veil of ice particles, or perhaps broken up into planet-sized spheres of water with thick outer shells of ice."[8] Faulkner believes instead that the use of the Hebrew term 'waters' (*mayim*) indicates that they somehow managed to remain in a liquid state.[9]

Humphreys, Faulkner, and Mortenson all claim that the cosmic shell view is the most natural reading of the text. The waters above *must be* beyond the stars, they insist, because they were positioned "above the expanse" which was named "Heaven" on Day 2 (Genesis 1:7–8), and God set the stars "in" that very "expanse of the heavens" on Day 4 (Genesis 1:14–19). But it's not so simple. Here are three exegetical reasons why the cosmic shell view should be reconsidered, and why the waters above need not have been placed beyond the stars.

Figure 1. Illustration from Martin Luther's 1534 German translation of the Bible, showing liquid waters surrounding the entire universe.

The cosmic shell view is at odds with the creation account's focus on known elements of the world and their relationship to humanity.

A careful reading of the creation account shows that it is concerned with letting readers know that God alone created the basic constituents of the world which were familiar to the ancients. It is also plainly concerned with mankind's position and role within the created order. Why would esoteric materials hidden at the edge of the universe be discussed in such an account?

All of the other items that God created according to Genesis 1 were familiar to and had a known impact upon the original Israelite audience. Genesis describes in simple terms God's creation of day and night; the land and seas; vegetation; the sun, moon, and stars; creatures that swim, fly, and walk; and mankind. All of these have important functions related to human beings. Land, sea, and sky were basic regions of the world that ancient Israelites could encounter. Celestial bodies with their daily cycle of light and dark were to serve as calendars, light sources, and more (vv. 14–15). Plants were given as food for man and beast (vv. 29–30). Animals of land, sea, and sky were to be ruled over by mankind (v. 28). By contrast with these familiar items and their relationships to humanity, any water billions of light-years from Earth could not have been observed by the ancients nor have had any relevance to daily life in the ancient Near East. If these were the 'waters' the author of Genesis had in mind, it is puzzling that they are mentioned in the text at all, let alone given the prominent attention they receive as a feature of Day 2.

Furthermore, there is no hint in Genesis 1 nor the rest of the Bible that God intended to reveal secrets about the large-scale structure of the cosmos which could not be discovered apart from special revelation. The idea that God was giving the Israelites advanced scientific revelation—the inside scoop on water locked up at the furthest extremes of the cosmos—simply does not comport with the teaching purposes of the Genesis creation account.

The cosmic shell view cannot sustain its supposition that the term *raqiya'* ('expanse') retains a single rigid meaning throughout Genesis 1.

As mentioned, a key assertion of Humphreys, Faulkner, and Mortenson is that the 'waters above' must be higher than the stars. But the Bible nowhere says that the waters are above the stars. It only says that they are above the *raqiya'* ('expanse') that God made on Day 2. The idea that the waters are above the stars is an inference based on two factors. First, the sun, moon, and stars were set "in the expanse (*raqiya'*) of the heavens" on Day 4 (Genesis 1:14–19). Second, it is argued that the term *raqiya'* retains a precise and fixed meaning throughout Genesis 1, permitting no variation between its occurrences on Days 2, 4, and 5.[10] But if *raqiya'* has only one meaning throughout Genesis 1, this leads to a problem.

On Day 5, God created winged creatures to "fly above the earth across the expanse (*raqiya'*) of the heavens" (Genesis 1:20). More literally, the Hebrew says that the birds fly "*on the face of* the expanse of the heavens". Both Humphreys and Mortenson think this detail weighs in favour of their interpretation. Against those who would equate the expanse with the atmosphere, they point out that the birds are not said to be *in* the expanse, rather they are *'al pene*, "on the face" of it. Humphreys says, "the literal Hebrew doesn't have 'in the open expanse'. It doesn't even have the preposition 'in'. Instead it uses another preposition, עַל ('al), which means 'on, over, above', but not 'in'."[11] Mortenson similarly says, "The preposition *al* never means 'in'."[12]

Humphreys and Mortenson are correct that *'al* does not mean 'in'. But they do not appreciate the significance of this fact for determining the location of the birds in Genesis 1:20, and thus the meaning of *raqiya'* in the context of

Day 5. Oddly, after emphasizing the fact that the birds are not said to be in the expanse nor in its face, they place them there anyway.

According to Mortenson, "the *raqiya'* extends from the water on the surface of the earth to the waters above", which he locates at the edge of the universe. But the "face of the expanse", he claims, "is the relatively very thin inside perimeter or veneer of the *raqiya'* [which] we call today 'the atmosphere'" (figure 2).[13] Humphreys agrees, claiming:

> "Birds can fly up to altitudes of 25,000 feet …, at which point they are above two-thirds of the atoms of the atmosphere. So most of the atmosphere is merely at the surface of the expanse. Therefore the expanse itself must be something much bigger—such as interstellar space" (figure 3).[14]

Is this really what the author of Genesis intended to convey, that the birds fly *inside* of the expanse's face, which is a region of considerable thickness (at least 25,000 feet)—only thin by comparison to higher heavens? Not at all. This interpretation fails for three reasons.

It is doubtful that a 'face' refers to a layer of any thickness rather than a surface.

First, the biblical evidence does not support the idea that a 'face' describes an outer layer that itself contains some depth. In the Old Testament, the Hebrew term "face" (*panim*) often refers to a face belonging to a human, another creature, or God. But when referring to objects, it refers to a surface, facing side, facade, border, or edge. Frequently it refers to the surface of the earth or sea. But it can also refer to the visible surface of the full moon (Job 26:9), the sharp edge—or perhaps flat side—of an ax head (Ecclesiastes 10:10), the east side of the Jordan River (1 Kings 17:3), the flat top of a column (2 Chronicles 4:13), the front surface of the mercy seat (Leviticus 16:14), the facade of the temple (2 Chronicles 3:17), the eastern border of Egypt (1 Samuel 15:7), and the visual appearance of the city of Sodom from a distance (Genesis 18:16). In all cases, the 'face' would include the contours, if any, of the surface, but does not extend beneath the surface to refer to the outermost layer of an object. For example, the face of an apple would refer to an exterior side visible to an observer, not to the apple's skin.

Some might allege that Job 41:13 provides a counterexample. The verse asks, regarding Leviathan, "Who can strip off the face of his garment?" (my translation). This obviously refers metaphorically to the creature's impenetrable scales. But even here the face need not be identical with Leviathan's 'layer' of scaly skin. The face could merely be the outer hard surface of his scaly skin. So there are no clear biblical examples where an object's 'face' is a layer of any depth, let alone one that is 25,000 feet thick.

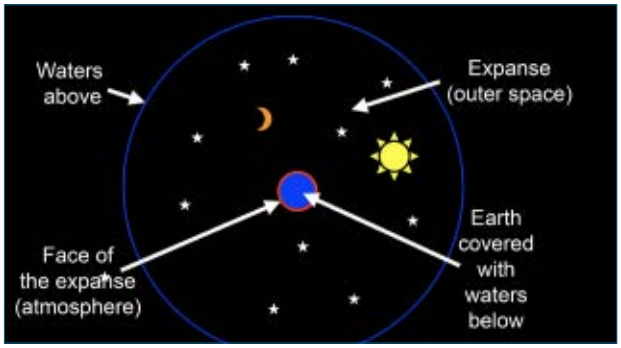

Figure 2. Diagram from Terry Mortenson's 2020 *ARJ* paper (ref. 6), p. 132, representing his interpretation of the biblical 'face of the expanse' as a relatively thin inner layer we now call the atmosphere. It is doubtful that the original readers of Genesis believed the 'face' was a layer, or that they conceived of the atmosphere as a thin part of a much larger expanse.

Mortenson claims that Scripture's references to "the face of the earth" have in mind a layer with some depth. He says the phrase refers to a "perimeter or layer or veneer of the earth" which is still "very thin compared to the radius of the earth".[13] But he does not offer any exegesis to demonstrate that this is what the phrase means. He appears to believe it because he says the face is "where people, plants, and animals live (even those that live in the ground or deep in the oceans)".[13] But an examination of texts that speak of creatures on "the face of the earth" (or land, ground, field, etc.) shows they typically describe land animals, not sea creatures. Fish are usually said to be "in the water under the earth" rather than on its face (Exodus 20:4; Deuteronomy 4:18; 5:8).

One possible exception is Zephaniah 1:2–3, which seems to use a broader definition of 'earth' that includes the regions of the sea as well as the dry land. But even if "the face of the earth" does include oceanic realms in this passage, this would still be consistent with the 'face' referring only to the surface of the ground, not a layer of earth and seawater. The biblical writers knew that land extended beneath the sea (Job 38:16; Psalm 18:15; Jonah 2:5–6; Nahum 1:4), so fish "on the face of the earth" would mean those above the seafloor.

As for the burrowing creatures, they are implicitly included among the group described in Genesis 7:23, for example, as "every living thing that was on the face of the ground". But if the face is a layer that encompasses their burrows, why aren't these creatures said to be *in* the face of the ground rather than *on* it? Burrowers are grouped with those on the earth's face because, first, burrowers spend some time above ground and, second, the text is making a generalization about the location of land-dwelling animals, not intending to pedantically describe every exceptional case. This is similar to the way God gave animals "every green plant for food" (Genesis 1:30) without meaning to exclude plants of other colours.

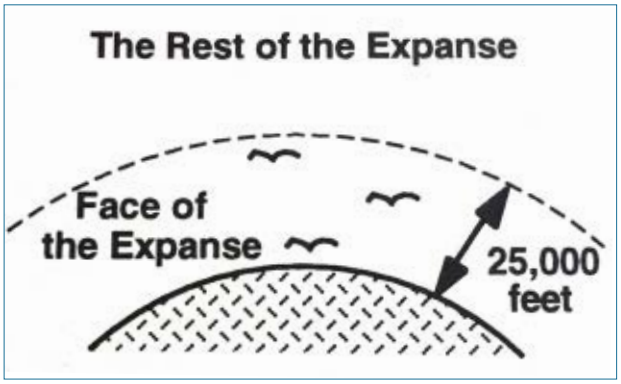

Figure 3. Diagram from Russell Humphreys' book, *Starlight and Time* (ref. 2), p. 60, representing his interpretation of the face of the expanse as an atmospheric layer. This view erroneously places birds inside the expanse (in its face) rather than outside of it (on its face) as the Hebrew phrasing in Genesis 1:20 requires.

In sum, no passages clearly portray an object's 'face' as a layer, so the proponents of the cosmic shell view have no sound basis for treating "the face of the expanse" in this way.

The original audience would not have considered the atmosphere to be a 'thin' veneer.

Even if the term 'face' could be used to describe a layer of some thickness, ancient Israelites did not have modern science to tell them that stars were vastly more distant than the heights achieved by birds and clouds, and the evidence we have suggests they did not think of the heavens in this way. In the Bible, clouds are frequently featured—more often than stars—as examples of extreme heights (Job 20:6; 22:12–14; 35:5; Psalm 36:5; 104:13; 108:4; Isaiah 14:14; Ezekiel 31:3, 10, 14). This is not to say that the Bible commits any error here, as no claim is made that stars are actually nearby. Scripture is silent about precisely how distant heavenly objects are. But it would be anachronistic to insist that the biblical author conceived of the starry heavens as so incredibly vast that, by comparison, the atmospheric region was merely a thin veneer. Here again, the cosmic shell view presumes that the Bible discloses advanced scientific insights—this time about the vastness of space. But there is no good reason to believe that the Israelites had this understanding. Thus, equating "the face of the expanse" with the region we call the atmosphere would have made no sense to them, so they must have understood the face to mean something else.

Birds are in front of the 'face', not inside it.

Even if the expanse's face were a layer 25,000-feet thick, and even if the Israelites thought that the face was merely a veneer compared to the rest of the heavens, it would still be problematic to locate the birds inside the face of the expanse, because the expression *'al pene* in Genesis 1:20 demands that the birds are *outside* of this face, not within it. Other uses of the phrase show that it refers to a position of being on, above, or in front of something. In Genesis 1:2, for example, "the Spirit of God was hovering *over the face* of the waters." In Genesis 6:1, "man began to multiply *on the face* of the land." In Genesis 19:28, Abraham "looked down toward [literally, *on the face* of] Sodom and Gomorrah". In all such cases, the subjects which are on or before the face are never positioned wholly inside it. They are outside of the face, either in contact with the surface, or situated opposite to it.

There are a few instances where objects partly penetrate a surface and are still described as "on the face", but these are not exceptions to the rule. For example, Genesis 1:29 says that plants were "on the face of all the earth", though their roots extended below the surface of the ground. Likewise, in Genesis 7:18, Noah's Ark "floated on the face of the waters" even though some portion of it was submerged. In these instances, the idea is not that the objects were suspended within the face of the earth or the waters, because this would be inconsistent with the use of *'al pene* elsewhere. Rather, the expression means that the visible portion of these objects rose up from the surface. It's only because they extended above the surface that they could be said to be "on the face".

Hence, based on Scripture's use of the phrase elsewhere, the birds which are *'al pene* in Genesis 1:20 must be outside (or at least extend outside) the face of the expanse. Humphreys and Mortenson place them entirely inside, so they cannot be correct. Faulkner is too vague on this point to critique.

A better way

The solution is to abandon the supposition that the 'expanse' must mean exactly the same thing throughout Genesis 1. The idea that the term 'expanse' can be flexible in meaning should not be surprising, since the expanse is coextensive with the 'heavens' (*shamayim*)—a term which is demonstrably flexible. Mortenson acknowledges this, calling *shamayim* an "imprecise word" which can refer to different aspects of the sky in different contexts.[15] For example, wind can blow "in the heavens" (Psalm 78:26), referring to the area where birds fly, yet the clouds can also "cover the heavens" (Psalm 147:8), meaning they block from view the portion of the sky that is further away. The term *shamayim* can even switch meanings within a few verses, without warning. For instance, Genesis 6:7 calls birds creatures "of heaven", but Genesis 6:17 classifies them as creatures "under heaven". Birds can be described in both ways because the term 'heaven' conveys different concepts in the two instances.

Humphreys even admits that there are multiple 'heavens' in Genesis 1. He says:

> "… on day one God made a space, called the heavens, which contained a large body of water, the deep. On day two [H]e made the expanse, which He also

called 'heavens', within the waters. Thus, there would be two heavens, the day-two heavens being a subset of the day-one heavens."[16]

If so, there is no need to presume that the phrase "expanse of the heavens" always refers to the Day 2 heavens.

In the case of Genesis 1:20 (Day 5), the most natural way to understand the phrase, "the face of the expanse of the heavens", is as a phenomenological description. This is because, as shown above, the face must be a facing side or a surface rather than a layer, and the birds are located on the near side of this face. The sky doesn't literally have a 'surface', but, using the language of appearance, it is natural to refer to the sky's opaque features apparent to a viewer as its 'face' (presenting side). So "the face of the expanse" refers to the appearance of the sky above as a background, just like the 'face' of Sodom that Abraham saw refers to its presenting side from his vantage point. The birds can fly *'al*—that is, in front of—this face without being *in* it because the face of the expanse is the visible backdrop, not the three-dimensional atmosphere.[17] This interpretation is the only one consistent with the true meaning of the phrase *'al pene* as it is used throughout Scripture.

This precludes the expanse of Day 5 from being identical to the expanse of Day 2. The Day 2 expanse extends from the waters above down to the surface of what became the sea, so it *must* include the invisible airy space where birds fly.[18] But on Day 5, the expanse clearly does *not* include the space where birds fly. The birds are outside of and in front of this expanse, so it must only refer to what is behind them.[19]

Once the expanse is acknowledged to have more than one meaning in Genesis 1, it can no longer be assumed that the waters above the expanse of Day 2 must also be above the expanse of Day 4. On Day 2, the upper waters could be clouds above the spacious region where birds fly—appropriately labelled "Heaven" (Genesis 1:8). But the Day 4 expanse could refer to the more distant part of the sky that appears to be blue during the day and populated by stars at night, no different perhaps to the Day 5 expanse. This variation in the meaning of the term 'expanse' is demanded by a careful investigation of its contextual usage, and such variation undermines any requirement that the 'waters above' be higher than the stars.

The cosmic shell view makes the 'deep' of Genesis 1:2 so vast that it threatens to undermine the contextual meaning of the terms 'earth' and 'deep'.

Before the waters were separated on Day 2, they were previously united as one body on Day 1, when they were called "the deep" (Genesis 1:2). Outside of Genesis 1, the 'deep' (*tehom*) typically refers to seas as well as subterranean waters that can rise to the earth's surface through springs. Another term that serves a similar purpose is 'depths' (*metsolah*), which is most commonly used to refer to deep seas. The 'deep' and plural 'deeps' or 'depths' are always treated as components of the 'earth' when the latter is defined broadly to encompass all regions under heaven, as opposed to mere dry land. For example, Psalm 148:7 says, "Praise the Lord from the earth, you great sea creatures and all deeps". The deeps belong to the realm of Earth.

Was this also true of the deep when it was first created? Yes. In Genesis 1, the deep is clearly associated with the 'earth' made on the first day. This is implied by two important exegetical considerations. First, Genesis 1:1 is not a summary of the creation account or an "introductory encapsulation" as Faulkner asserts.[20] It is the first creative act of Day 1. There are several strong reasons to regard it as the initial event, including the fact that in Hebrew there is a *waw*-conjunctive (translated "And" or "Now") connecting verses 1 and 2. This is sandwiched between "the earth" at the end of verse 1 and the same term at the beginning of verse 2. Such a construction indicates that verse 2 is a circumstantial clause describing the state of the earth just mentioned, which involves an unfinished earth, not a completed one. Thus, verse 2 is not a description of conditions prior to any of the narrative's events, but the state of affairs that resulted from verse 1.[21]

Also, Genesis 1 uses the classic formula for opening Hebrew narratives. It has a temporal clause ("In the beginning") followed by a perfect verb ("created") in verse 1, which regularly depicts the first event of a narrative. Next in the pattern comes a series of *waw*-consecutives ("and" prefixed to imperfect verbs). These describe subsequent events, exactly as found in Genesis 1 ("And said … And was … And saw … And separated …").[22,23]

Furthermore, if verse 1 were an encapsulation of the whole week, then the earth and the deep would already have been present prior to the beginning of the account, without any explanation as to how they came to be. Ironically, if this were the case, the text would not actually describe the ultimate origin of the earth despite the claim of the encapsulation. No, the text means to say that God's first act to kick off Day 1 was to create the regions of heaven and earth.[24]

The second consideration is that the phrase "the heavens and the earth" in Genesis 1:1 is a merism—combining two opposite extremes to refer to a whole. The phrase refers to the realms that comprise the entire (though as yet undeveloped) universe. It is not an exact *synonym* for 'universe' since the constituent parts are retained in the meaning.[23] That is, the distinct regions of heaven and earth came into being with this first act of creation on Day 1, and they constitute the totality of physical realms. Also, because the context is about the first act of *ex nihilo* creation, here the expression would necessarily be inclusive of whatever contents these realms

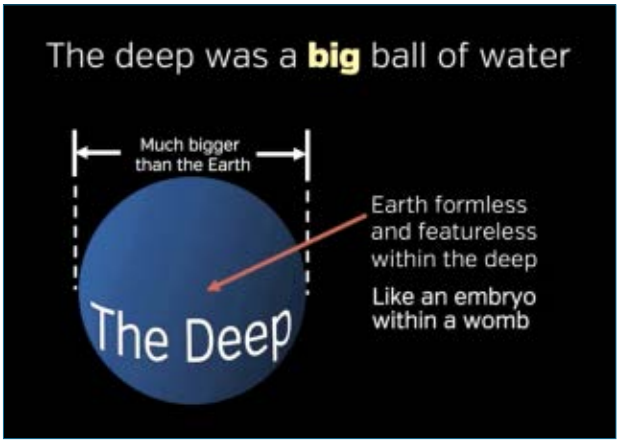

Figure 4. Russell Humphreys' diagram, representing his view of the Day 1 'deep', from *Light-Years? No Problem!* DVD, Creation Ministries International, 2016.

initially contained, such as the primordial waters discussed in the next verse.[25]

Verse 2 then comments on the state of the earth after its creation, and makes first mention of the 'deep'. Since God's creation of "the heavens and the earth" was the first creative act, and since these realms comprise the whole of creation, the deep must belong to one of them. Because verse 2 narrows the focus to the earth by itself, the deep in context belongs to the earth, not the heavens. Therefore, the term 'earth' in Genesis 1:1–2 does not refer merely to hard ground, but implicitly includes the waters of the deep. Even in its primordial state, the deep was created as a fixture of the earth.

The problem that then arises for the cosmic shell perspective is that this theory requires the deep to be so enormous that it becomes hard to see how it can be either part of or synonymous with the primitive earth. Consider how much water the cosmic shell view supposes was in the deep. The deep consisted of all of the 'waters above' and all of the 'waters below' prior to their separation. If the 'waters above' now encompass the entire three-dimensional universe—even as widely scattered ice fragments or liquid droplets—they must represent an enormous amount of mass.

Exactly how much space would the waters have occupied when they were originally combined on Day 1? Faulkner and Mortenson do not offer any specific estimates of the amount of material contained in the waters above or in the original deep. Mortenson cautions, "We have no biblical basis to say how much water is above the heaven or how thick that watery boundary is."[13] But we do know that the universe is extremely large, so even a thin, sparse cosmic shell would require a lot more water than is now present on the earth.

Admittedly, without specific numbers, Faulkner and Mortenson might be hard to pin down on this point. But Humphreys has speculated about the size of the initial deep, and his figures illustrate the difficulty.

Humphreys' book, *Starlight and Time*, suggested the initial deep might have been a sphere "greater than 2 light-years in diameter".[26] In recent presentations, he has increased this to 20 light-years. Even the smaller figure of 2 light-years is mind-bogglingly huge. The diameter of today's solar system, using the orbit of Pluto as its boundary, is merely 10 light-hours.

Humphreys does not try to claim that this enormous ball of water should be thought of as the early earth. No, he says, "The earth at this point is merely a formless, undefined region of water at the center of the deep, empty of inhabitant or feature."[26] His presentations make it clear that the earth would be a tiny fraction of this material (figure 4). Planet Earth today has a diameter of about 1.35×10^{-9} light-years—more than a billion times smaller than Humphreys' watery deep.

Given Humphreys' view that the earth was tiny compared to the waters—absolutely dwarfed by an incomprehensibly large deep—it makes little sense to think of the deep as *part of* the primitive earth. The Bible presents the deep as a component of the earth, but Humphreys presents it as a collection of waters so vast that the earth virtually disappears inside it. If Humphreys' depiction were correct, Genesis 1:1 should have said that God created the heavens and the deep, not the heavens and the earth.

I have not been able to ascertain Mortenson's stance on the relationship between the primitive earth and the deep, but Faulkner takes a different view than Humphreys. He maintains that "the earth created at the beginning of Day One was a water mass", which he equates with the deep.[10] So, unlike Humphreys, Faulkner correctly believes that the primitive earth contained the entire deep. But if Faulkner joins Humphreys in thinking that the deep originally took up dramatically more space than planet Earth occupies today, problems remain.

Whereas Humphreys faces a challenge with the biblical conception of the 'deep', Faulkner faces a challenge with the biblical conception of the 'earth'. For example, consider a scenario in which Faulkner's water mass started off comparable in size to Humphreys' ball, 2 light-years in diameter. In this case, it would not seem reasonable for Genesis 1:2 to describe this enormous object as "the earth". Being composed of water is not the problem, as Faulkner reasonably argues that the term 'earth' can refer to "primordial matter that would become the earth as we know it now."[10] Yet, with a water mass of this size, the vast majority of it would *not* have served as raw materials which God transformed into our terrestrial planet. The bulk would instead have been swept to the edge of the cosmos. Faulkner's so-called 'earth' would have been composed almost entirely of matter that became 'cosmic shell' and hardly any 'earth' at all.

It might be argued that one could rescue both Humphreys' and Faulkner's models from the above criticisms by postulating a cosmic shell which is dramatically less thick or less

dense than Humphreys has supposed, so that far less water would be required in the original deep. However, it is not clear that any specific amount of water will alleviate the difficulty. For one thing, the universe could easily turn out to be much larger than our current estimates of its minimum size, exacerbating the problem. But even assuming a universe no larger than we can measure today, it may not be possible to find that 'just right' amount of water which is great enough to form a shell yet still minimal enough to fit on the earth. In my judgment, even a spherical water mass which was merely double our planet's diameter is already too large to be faithful to the biblical terms 'earth' or 'deep'. Yet if that same relatively small volume of water now surrounds the universe, it could only form a hopelessly meagre shell which would seem too insubstantial to be worthy of the description, "waters … above the expanse" (Genesis 1:7). If these assessments are correct, then no carefully chosen amount of water will allow the cosmic shell view to overcome this objection.

Conclusion

Although the cosmic shell view of the 'waters above' attempts to faithfully interpret the events of Day 2 of Creation Week, the problems highlighted here reveal that this proposal is not the most natural reading of Genesis 1. Hopefully, this contribution will encourage those who currently hold to the cosmic shell perspective to revise or abandon it.

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13. Mortenson, ref. 6, p. 131.
14. Humphreys, ref. 2, p. 61.
15. Mortenson, ref. 6, p. 113.
16. Humphreys, ref. 2, p. 64.
17. The same concept is expressed in the New Testament, when Jesus referred to the 'face' (*prosopon*) of the sky, specifically its red colour and its cloud movements (Matthew 16:2–3; Luke 12:54–56). For Jesus, the 'face of the sky' is its phenomenal appearance.
18. This is where Kulikovsky's view breaks down. He takes the waters above to be a cosmic shell but views the 'face of the expanse' not as the atmosphere but as "the boundary of interstellar space [which] is much further away than the bird." So he does not believe the atmosphere is part of the *raqiya'*. But the text describes only one expanse between the waters. There is no basis for introducing a second atmospheric expanse below the first. Kulikovsky, A.S., *Creation, Fall, Restoration*, Mentor, Fearn, Ross-shire, Scotland, pp. 129–132, 137, 2009.
19. We similarly switch between meanings of the term 'sky' and recognize the distinctions subconsciously with only subtle context clues. For instance, we might refer to trees that touch the sky, and elsewhere say that the sky is blue. Nobody should conclude from this that the trees must be in contact with the blue colour, because 'sky' is used differently in the two cases. The trees reach into the sky defined to include the invisible space just above us. But the blue sky does not refer to the nearby invisible air; it only refers to the visual appearance of the background further away.
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24. Some say that this first event occurred prior to the first day, but Exodus 20:11 dispels this error.
25. In other contexts, the contents of the "heavens and earth" are distinguished from these realms (e.g. Genesis 2:1), but the phrase is a merism regardless of whether the totality includes only the realms or also their contents.
26. Humphreys, ref. 2, p. 32.

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The surprisingly complex tRNA subsystem: part 5—evolutionary implausibility

Royal Truman

The genetic code is contingent on several indispensable components. Parts 1–4 of this series documented how dozens of protein molecular machines are necessary to prepare and process the members of one subsystem, the collection of tRNAs. But without functional linker molecules the necessary protein cannot be manufactured. Evolution theory is incompetent to solve this chicken-and-egg problem.

Given a putative, primitive ancestral code, mathematical modelling demonstrates that at most four *precise* mutations (or the statistical equivalent in the case of alternative solutions) could have been generated in 10 billion years. This does not provide a feasible means to produce various features, including: a) the multiple tRNA-specific enzymes involved in some chemical modifications; b) the precise 7-nt target sites found in several *Drosophila* genomes perfectly complementary to the regulating 5′-tsRNAs; nor c) miRNAs derived from tRNAs having perfect seed regions of about 7 nucleotides.

In part 1 of this series, we showed the genetic system is composed of several indispensable subsystems.[1] Cellular subsystems consist of multiple biochemicals assembled in a precise time order with elaborate quality control measures. They function holistically, involve several processing steps, and are integrated with other cellular subsystems. To illustrate the concept of a subsystem, consider the eukaryote intron splicing cycle.[2–4] A spliceosome assembles and then disassembles nine discrete complexes sequentially, using different ensembles of snRNAs (small nuclear RNAs) and proteins. Some of the biomolecules are only needed temporarily to produce the next complex in the pathway. Maturation of many of the sub-assemblies requires trafficking between the nucleus and cytoplasm for special processing, with many quality-control measures to prevent errors. Over 200 proteins are involved, and all the complexes consume much energy, but only the last complex provides any value. Understanding in detail the design principles of one subsystem provides key insights to understand the hundreds of other subsystems found in cells (such as miRNA processing, nuclear pore trafficking, horizontal gene transfer, and so on).

Various evolutionary theories postulate either a DNA, RNA, or protein-only predecessor to extant life. A theory requiring multiple classes of pure, complex biomolecules at the right time and place would not be consistent with naturalism. However, deeper analysis of genetic subsystems reveals they are all dependent on DNA, RNA, and proteins concurrently to be viable. The subsystems themselves consist of parts which are irreducibly complex.

The motivation for this five-part series was to analyze the genetic system, but focusing for now on the simplest subsystem, a collection of transfer-RNAs (tRNAs).[1] Many assume only RNA molecules would be necessary to serve as adaptor molecules to translate codons. Knowing the other subsystems are considerably more complex, such as ribosomes[5] and aminoacyl-tRNA-synthetases,[6–9] we chose to defer analyzing them for later.

The protein-based synthetases are responsible for attaching the correct amino acid in a high-energy bond to the correct tRNA at a precise nucleotide (nt) position. What came first? Without aminoacyl-tRNA-synthetases proteins will not be produced, but aminoacyl-tRNA-synthetases consist of proteins. Without aminoacyl-tRNA-synthetases, tRNAs are worthless as translation adaptor molecules. Without tRNAs, aminoacyl-tRNA-synthetases are worthless. Crucially, a living cell cannot exist without a functioning genetic system, comprising all its interacting subsystems (see part 1).

Dozens of kinds of tRNAs are needed to translate the genetic code, codon by codon to produce the protein sequences specified on DNA. In part 1, we showed that transcribing and processing pre-tRNAs in the appropriate amount and right time requires protein-based molecular machines in all life-forms.[1] In parts 2–4 we provided insights on how tRNAs are processed, trafficking between the nucleus and cytoplasm multiple times.[10–12] We also described many cellular processes they are involved in.

Here in part 5 we will consider whether evolution is a plausible explanation for these observations. Evolution faces two conceptual problems. The first is the absence of a simple but realistic starting point for the tRNA subsystem. Second, should a minimally viable primitive genetic system have arisen naturally, could the additional processes in which tRNAs are involved in have arisen through evolutionary processes? Before we examine both questions, we must be cognizant of some key principles.

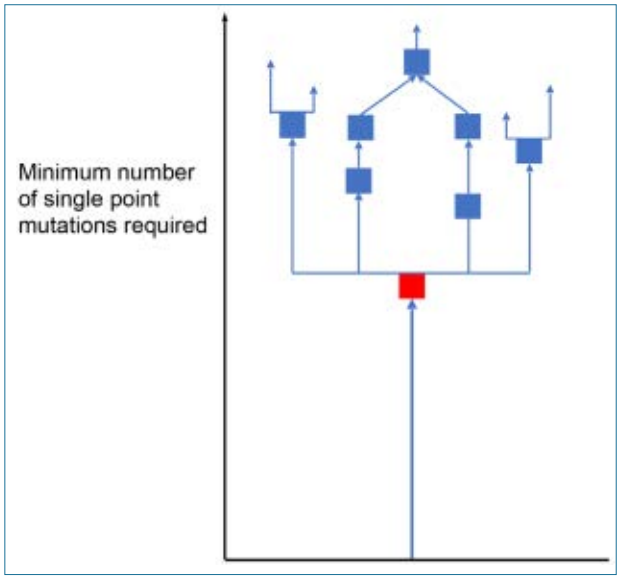

Figure 1. Multiple mutations are necessary to provide a minimally functional starting point natural selection could recognize (red box). Afterwards beneficial mutational paths might exist to refine the initial state.

Minimal functionality for a new feature to arise

Entirely new biological features are not built with only one nucleotide. Many nucleotides must participate jointly, as an entity which serves as a starting point with at least minimal functionality (see the red box in figure 1).

To illustrate, suppose a trinucleotide 'ATG' is to serve as the *Start* codon for translation at a genome position which currently contains CCC. Intermediate mutations such as CCC → *A*CC → *AT*C → are not advantageous whenever one more nucleotide matches the functional pattern. In this example, the single-nucleotide mutational path would require no less than three single-nucleotide mutations at specific locations before any benefit accrues. But why should a 'correct' mutation always occur? A more convoluted path would be expected, such as CCC → GCC → G*T*C → G*T*T → *AT*T → *AT*A → *ATG*.[13]

Multiple mutations destroy features more rapidly

Perhaps a few fortuitous double mutations could occur in a mutation-prone region. Might this facilitate obtaining the right pattern, through a sequence of mutations such as CCC → *AT*C → *ATG*? It turns out that multiple concurrent changes would accelerate destruction of the pattern just generated. Let us elaborate.

Perhaps the pattern needed is within one or more hot mutational spots or recombination areas. The example in figure 2 proposes that the ATG pattern is located within a 6 nt high mutation region. We see that 3/6 of the possible point mutations would destroy the function; 12/15 of the double mutations; and 18/19 of the triple mutations would do so. (The rapidly mutating region need not be adjacent; the pattern could be distributed across multiple such regions). We conclude that random mutations will destroy a specific, useful pattern faster when: it is comprised of more nucleotides; mutation rates in that region are higher; and multiple concurrent mutations occur.

In the analysis below we require only minimal functionality, to facilitate a theoretical evolutionary starting point. Consequently, selective advantage would be small at such time, precluding rapid spread through a population. The mutated members would be highly vulnerable to destruction by additional mutations.

'Statistic equivalency' to analyze necessary mutations

In the example above, the ATG pattern consists of adjacent nucleotides which are intolerant to mutations. This is the simplest case to analyze mathematically. More complex examples would require using Bayesian statistics or Shannon information theory. However, our purpose here is to evaluate whether evolution is a reasonable explanation for the tRNA subsystem, and we wish to avoid unnecessary sidetracking complexity.

There are many examples of the conceptually simplest case which involve invariant adjacent nucleotide patterns, such as the seed location of miRNAs (red nucleotides in figure 3A). Various binding sites on DNA, RNA and proteins have this property and are generally described using consensus sequences or sequence logos.[14]

Scenario B of figure 3 shows how requiring either of two nucleotides at two precise locations is statistically equivalent to requiring a certain nucleotide in one position. In some cases, multiple separated patterns are needed (scenario C in figure 3). An example is the individual patterns necessary to recognize the 5' and 3' ends of an intron plus the branch point.[15]

Additional informational patterns outside of key highly invariant positions are usually necessary to ensure correct targeting. Identifying and characterizing the additional requirements can be difficult, which is why bioinformatics algorithms are less than 100% accurate.[16,17] We conclude that the necessary informational patterns can be a combination of invariant positions along with a subset of acceptable nucleotides at other positions.

We now introduce the notion of 'statistical equivalency'. In some cases, a *specific* nucleotide might not be necessary at a genomic position. Instead, a genetic solution could be satisfied through multiple collaborating nucleotides. This makes design sense, permitting rheostat-type activity levels.

Many alternative patterns may work, but with different durations or rates.

Obtaining multiple but less stringent mutations by chance is often less probable than requiring a single specific mutation. This can be observed from sequence logos which permit probability calculations. A portion of a pattern containing more than two bits of Shannon information is less probable than requiring a specific nucleotide out of four possibilities, since $\log_2(4) = 2$. Therefore, the pattern in figure 3B can be considered to contain the *equivalent* of at least six invariant nucleotides, especially when one knows that additional unidentified signals are necessary.

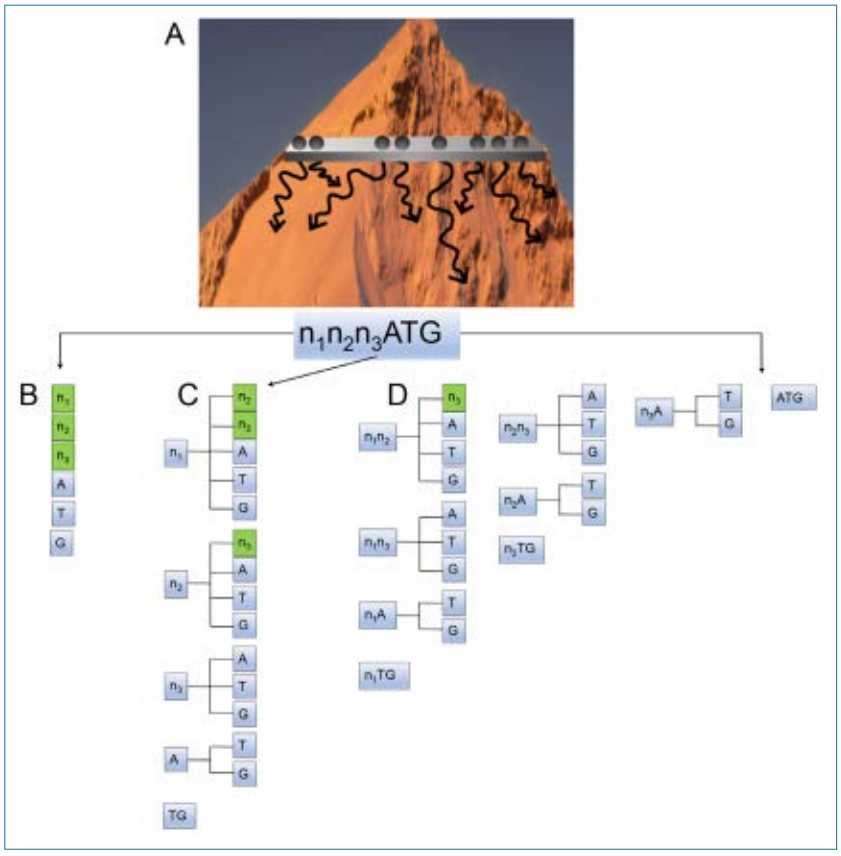

Figure 2. Features encoded on a genome are easily destroyed by mutations. **A**. Mutations are more likely to degrade or destroy a function than improve it. **B–D**. Sequence ATG represents a target Start codon. These and three other nucleotides (n1, n2 and n3) are assumed to reside in a rapidly mutating region. Green boxes are mutations which do not damage the Start codon. **B**. Single mutations. **C**. Double mutations. **D**. Triple mutations.

Maximum number of specific mutational events

In *The Edge of Evolution*, Behe estimated the maximum number of *specific* mutations which could be demanded from an evolutionary explanation as the starting point for an innovation.[18] He used empirical examples which required one or two specific amino acids be modified.

P. falciparum, a eukaryotic parasite transmitted by mosquitoes, is the main cause of malaria. Various medications have been used to kill this parasite. A single point mutation in the *cytB* gene confers resistance to atovaquone and a single point mutation in the *dhfr* gene resistance to a different drug, pyrimethamine. Medical studies have established that 10^{12} parasite multiplications are necessary for each *de novo* case of parasite resistance to these two drugs.[19]

An adult with malaria carries ~10^{12} parasites, but in the laboratory much higher mutation rates than 10^{-12} were recorded.[19] Why is parasite immunity not arising more frequently? One possibility could be that the mutations lead to fitness disadvantages until exposed to the drug. In addition, human immunity might prevent some of the resistance-conferring mutations from being effective.[19]

These are important considerations. Another fact is that many random mutations will be 'wasted' in the exploratory process, generating identical mutations and mutational reversals. If one out of *n* genomic positions must be mutated, it will take far more than *n* random mutations to ensure every position has been 'tested'.

P. falciparum feeds on the protein part of hemoglobin but the heme part is poisonous. Heme is normally processed in the parasite into hemozoin which can be disposed of. The drug chloroquine functions by inserting itself into the parasite's digestive vacuole where it interferes with the production of hemozoin. The protein transport pump *PfCRT* is responsible for importing various substances into the vacuole, fortuitously also the therapeutic chloroquine. Analysis of all *P. falciparum* lineages which are resistant to chloroquine revealed that the same two amino acids had mutated, at positions 76 and 220 of *PfCRT*.[19,20]

Medical studies show that less than 10 independent cases of spontaneous immunity have arisen since chloroquine was first used. It is also known that the malarial parasite genome consists of about 10^8 nucleotides. Taking into account the average number of infected worldwide per year and parasites per sick person led to the conclusion that about 10^{20} *P. falciparum* cells would need to mutate to confer a single case of immunity, which involved exactly two amino acids.[19] Since most of the unsuitably mutated versions would be

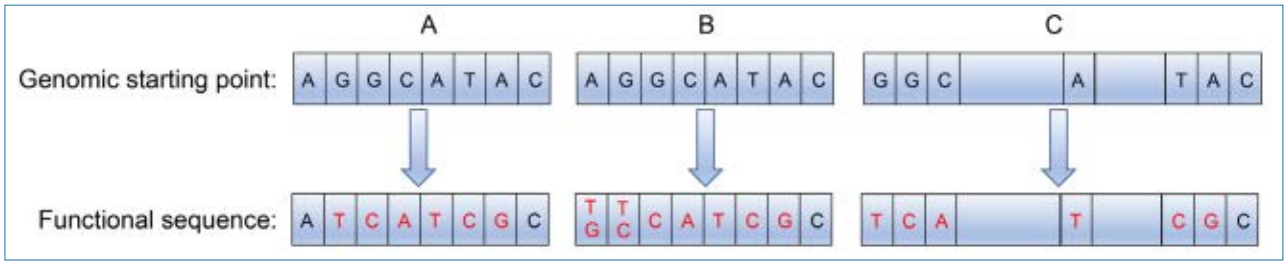

Figure 3. Statistical equivalence of mutations. **A.** Six *exact* mutations could produce the necessary hexanucleotide pattern. **B.** If two nucleotides would be acceptable for the target pattern at two positions, and mutations are equiprobable, then this is statistically equivalent to case A. **C**. The six nucleotides required for a pattern need not be adjacent.

killed by the drug, the 'correctly' mutated would face fewer competitors in a cell and reproduce rapidly. Transmission by mosquitoes to new hosts would quickly spread the resistant strain, and therefore chloroquine is now usually ineffective.

When *P. falciparum* is no longer exposed to chloroquine the proportion of mutant strain declines and the original strain dominates. Although less fit in almost all environments the double mutation is indispensable for survival of the parasite in the presence of this drug.[21]

Since mutating a nucleotide in a codon in most cases will code for a different amino acid, we can continue the analysis by referring to nucleotides. We have established so far that empirically about 10^{12} mutational events would be necessary for a single cell eukaryote having a genome of about 10^{8} nucleotides to achieve a specific evolutionary novelty, and 10^{20} mutational events when two specific mutations are needed.

Most of the organisms which have lived on earth are prokaryotes and about 10^{30} are produced worldwide annually.[22] Since evolutionists believe life on earth began less than 10 billion years ago (10^{10}) then less than 10^{40} mutations could have ever occurred.

Behe pointed out that if about 10^{20} organisms would be needed to produce two specific mutations, then 10^{40} would be necessary for an evolutionary innovation initiating from four mutations.[18] The limitation to four or less specific mutations applies to every step of every putative evolutionary trajectory (figure 4A). This illustrates the power of Behe's concept of irreducible complexity. If evolution is true, then complex innovations which require multiple new and interacting genes, such as to create the cilium, must have occurred though countless relatively small steps, all without a guiding plan.[23]

Realistic maximum number of specific mutational events

Far fewer than the maximum number of random mutational events, 1×10^{40} could be applied to develop a particular innovation for several reasons.

1. Far more mutations are deleterious than beneficial. According to a review article written by two specialists, for *Drosophila* and enteric bacteria the proportion of deleterious *amino-acid-changing mutations* is at least 84% and 97.2%, respectively. Requiring several specific amino acids is therefore especially difficult.[24] Comparison across many organisms has revealed far less variability than expected if *non-protein coding sites* were mutationally neutral. The 'Junk DNA' myth has been very damaging to science and has strongly influenced speculative claims about a high proportion of effectively *neutral* mutations. For organisms such as yeast, nematodes, and *Drosophila melanogaster* about 50% of *all* mutations may be deleterious.[24]
2. In three mutagenesis experiments the proportion of advantageous mutations obtained were 0% in *Escherichia coli*, 0% in the bacteriophage Φ6, and 6% in *Saccharomyces cerevisiae*. Therefore, lineages accumulating more mutations will on average have proportionally fewer members. This makes it increasingly difficult to collect enough changes to generate a fortunate genetic pattern natural selection could act on.[25]
3. The stochastic nature of survival and reproduction across many generations will cause most useful mutations to be lost over deep time instead of fixing in the population.[26]
4. For fixation to occur, the cells with a beneficial mutation must out-compete all those lacking it, wiping out all alternative evolutionary possibilities (figure 5). This would happen again and again for every discrete level of improvement shown in figure 4A.
5. The relevant mutations must occur within a specific class of organism.
6. The mutations must occur within a relevant time window.
7. The difference between standing (N) and the effective (N_e) population sizes must be considered. A recent study of 153 species (152 bacteria and one archaeon) led to estimated effective population sizes N_e on the order of 10^{8}–10^{9}, even though their census numbers are orders of magnitude higher.[27] The cyanobacterium *Prochlorococcus marinus* is the most abundant photosynthetic organism on Earth. Census populations can be upwards of 10^{13}, but the N_e is only about 10^{8}.

An excellent way to research this topic is by using Mendel's Accountant, the leading population genetics simulation program available.[28]

The above analysis indicates that fewer than the statistical equivalent of four *specific* mutations can be invoked to claim a naturalistic origin for a cellular novelty. Innovation, however, is not the same of loss of function. If in a particular environment an organism no longer needs a complex feature, any mutation able to deactivate it will be beneficial. Material and energy would be saved along with fewer opportunities for genetic errors. Therefore, the opportunities to simplify and streamline will not be limited to just one mutation at a single genomic site.

Improbability as merely a statistical outlier?

Statistically unlikely events do occur. Perhaps we would be over-rating a fortunate evolutionary accident upon finding a four specific mutation example. To judge this possibility, one needs to examine several examples and in more detail. Obtaining a Start codon at the correct location to define where to begin translation in one case is remarkable. But finding this thousands of times in the same prokaryote species cannot be shrugged off as a curiosity, especially if we include additional requirements such as the need of a suitable termination codon. But more significantly, a Start codon alone is worthless without the new required proteins which interact with it and each other.

Let us review what is involved in a minimal protein-protein binding interaction. After folding into a stable three-dimensional shape, part of a protein surface must offer a series of indentations and projections which act like a lock and key. Shape alone is not enough; chemical electrostatic properties are also needed (using the right amino acids with net positive and negative charge distributions) as well as hydrophobic surface patches.

Dr Winter and co-workers at the Medical Research Council in Cambridge, England spent several years examining how proteins bind. They generated a huge number of mutant proteins with random amino acids confined to coherent patches. Despite having deliberately guided the mutations toward an intended goal, they found that a library containing between 10 million and 100 million variants is needed in order to get a particular protein to bind to another one with at least modest strength.[29,30] Behe estimated that this is statistically equivalent to requiring a precise residue in a specific location *five or six* times (20^5 or 20^6).[31]

We saw above that mutations from all organisms which ever lived would provide fewer opportunities than necessary to generate a *four* specific amino acid pattern. Note that not only must stable binding occur, but it must also be restricted to the proteins which jointly provide a useful biological function. Less demanding interactions, using fewer amino acids would generally be too weak, and would lead to many interfering wrong interactions. In addition, there are many positions on a protein's surface at which weak binding could occur, so the potential for incorrect associations would be immense.

Bruce Alberts, former president of the US National Academy of Sciences has pointed out that nearly every major process in a cell requires assemblies of *10* or more protein molecules.[32] A mere binary interaction between proteins A and B would have required nature to generate and test about 10^{20} binding sites and a tertiary interaction A-B-C would have required testing about 10^{40} alternatives. Random mutations could not have produced anywhere near 10 correct protein-binding interactions.

The flagellum has *dozens* of protein parts that bind specifically to their correct partners; the cilium has *hundreds*. All the correct partners must associate, with binding to only suitable locations which generate the functional topology. In total there are thousands or tens of thousands of protein-protein binding sites in free-living cells.

Improbability as a *post facto* artefact?

One might object that an observed feature seems very unlikely to have arisen by chance, but unusual things do occur which had not been predicted in advance. Perhaps there are many random DNA patterns which offer opportunities for innovation and something useful was bound to happen. This is a poor argument. How often has inserting random DNA into a genome produced new useful functions? Let's examine this objection more closely.

There are many examples of cellular features which permit little sequence variability. Examples include extreme protein invariability,[33] or mandatory perfect 7–8 nt miRNA:mRNA pairing *to hundreds or thousands* of mRNA partners. Chance mutations will not produce a new miRNA seed region which just happens to be able to regulate the right *ensemble* of mRNAs, plus all the proteins needed.[34] But the full picture is statistically worse. Dozens to thousands of different miRNA seed patterns each regulate a distinct collection of mRNAs, depending on the organism.[35]

As another example, one could argue that splicing out a spliceosomal intron might occur by chance, since evolution had not predicted *this particular one* had to be removed. Perhaps a multitude of other introns had gotten inserted at the same time. Consider, however, that a lineage having no or very few introns would have out-populated a seriously damaged lineage. Many or all introns would need to be removed at the same time at an evolutionary starting point to compensate for the burden of carrying all the additional spliceosome proteins.[36] The correct consideration is not whether chance

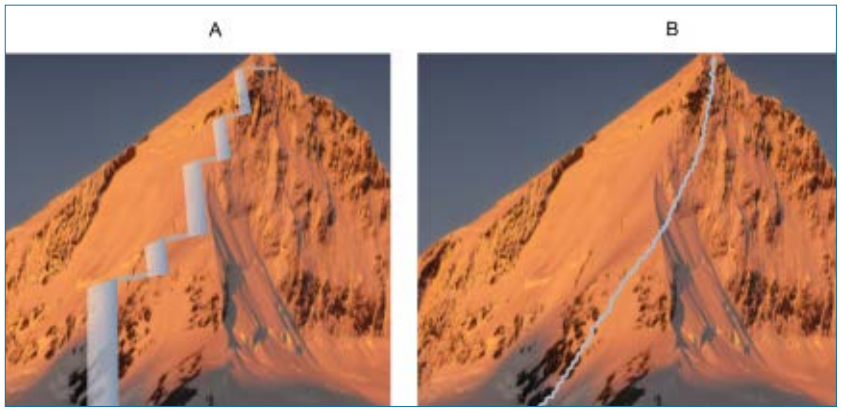

Figure 4. Two views about the difficulty of creating new biological functions through random mutations. **A**. From an initially non-functional state many mutations would be needed to provide a starting point for natural selection and many *specific* mutations would be necessary for many of the subsequent improvement stages. **B**. An easy evolutionary path is assumed to exist whereby only one, or very few *non-specific* mutations would immediately be sensed by natural selection. No biologically plausible examples of such a trajectory have been proposed.

mutations could have removed a single damaging intron, but all of them.

Should one question evolutionary theory?

We should reject narratives in science, medicine, court cases, economics, and other areas if the theories are based on a series of statistically unrealistic 'Insanely Improbable Chance Change' (IICC) events. After this rather lengthy preparation we are now ready to review some of the tRNA features mentioned in parts 1–4.

Could a *minimally* viable tRNA subsystem have arisen naturally?

At some point in the evolutionary narrative there must have been an ancestral cell with the key features we observe today. This includes transcription, translation, an outer membrane, reliable energy production, metabolism, and reproduction. We'll call this the 'FUCA' (First Universal Cellular Ancestor). This hypothetical entity would be as simple as possible but must be viable and fulfill the minimal requirements to be defined as a cell. The subsequent LUCA (Last Universal Common Ancestor) is not claimed to be minimally complex, and we are referring to a still earlier putative organism.[37]

If a FUCA never existed, then extant life could not have arisen from a common ancestor. We are not interested here in prebiotic or RNA world speculations *preceding* a FUCA. We are referring to an unavoidable stage in a conceptual evolutionary trajectory. It cannot be circumvented. This putative ancestor would have required dozens of functioning tRNAs to serve as translation adaptor molecules.

When might the tRNAs have arisen? There are only two possibilities. Either they arose exactly *simultaneous* with the FUCA, or *before*. By the definition of a FUCA, the tRNAs could not have evolved later. Any conceptual entity lacking a minimal tRNA-based translation would have been pre-FUCA.

Could tRNAs have arisen simultaneous with a FUCA?

Perhaps an ensemble of tRNAs appeared simultaneous with all the other parts necessary for a FUCA to be viable. This view would recognize the holistic nature of cells and how the subsystems are inextricably linked. The FUCA would reliably synthesize many copies of all necessary tRNAs (i.e. each with a suitable secondary structure and appropriate anti-codon). This scenario would not be consistent with naturalism, however. It would be indistinguishable from a miraculous event.

The chicken-and-egg dilemma would still be present, although now shortened timewise. The very first mRNA translated would have required functioning tRNAs. One cannot admit that tRNAs are a prerequisite for translation but claim that the FUCA manufactured them. This manufacturing process would require functioning transcription and biosynthesis, meaning the *pre-existence* of proteins which themselves depend on translation using tRNAs. Therefore, a naturalist should reject the first conceptual possibility, but not a creation scientist.

Could tRNAs have arisen before a FUCA?

If the first FUCA did not immediately begin manufacturing tRNAs, then these would have had to already exist and somehow been made available to a FUCA's ancestor. Admittedly, this poses major difficulties, but this is the only alternative available. A constant supply of tRNAs would have been necessary for translation during the pre-FUCA period. This strategy would have to then be replaced in the FUCA by DNA which encodes these tRNAs plus all the features to transcribe them. The entire chain of evolutionary intermediates would have to occur with no intelligent guidance and all the stages would need to remain viable. Is this reasonable?

Long RNA single-strand sequences will form secondary structures whenever intramolecular folding brings regions of base-pairing counterparts into contact. In part 2, we showed that tRNAs will not fold into the necessary secondary structures without dozens of additional biochemical modifications.

Some modifications prevent incorrect base pairings, and others are needed for correct pairings to be possible. This poses a chicken-and-egg dilemma, since the prerequisite enzyme proteins cannot be manufactured without functional tRNAs.

Postulating a naturalistic origin of the complex aminoacyl-tRNA synthetases and ribosome molecular machines is already unreasonable. But now we see in addition that the predecessor tRNAs would lack the necessary three-dimensional structural integrity for these to operate on and with. Extraordinary structural precision on parts of tRNAs are necessary to avoid mischarging activated tRNAs and to avoid translation reading frame errors.

A naturalist is now confronted with a dilemma. Either reject the first scenario based on philosophical preference or reject the second scenario based on sound logic.

Evolution of additional improvements by tRNAs

Some naturalists may wish to ignore the lack of a feasible starting point for tRNAs in a FUCA but argue that subsequent evolutionary innovations could occur naturally. Theistic evolutionists might claim this. Other worldviews postulate occasional divine miracles followed by *unguided* evolutionary processes. We will review some of the processes tRNAs participate in to judge the merit of these views.

Examples requiring more than four precise mutations on contiguous positions

The study referred to in figures 3 and 4 of part 4 documents how ~44 genes are regulated by a *specific* tRNA fragment, tRF5-GluCTC.[38] A specific *17-nt* perfect adjacent base-pairing patch (plus several more in another region) is necessary to target the mRNA of APOER2, a cell surface receptor involved in signal transduction and endocytosis. We proposed that the RSV virus might have been designed to stimulate production of tRF5-GluCTC and thereby regulate these 44 genes. The more than 17 *perfect pairs* between tRF5-GluCTC and the mRNA of the APOER2 protein could not realistically be attributed to random mutations. Claiming a correct group of 44 genes then became properly regulated through chance mutations pushes credibility into absurdity.

In another study discussed in part 4, several *Drosophila* genomes possess some *7-nt* regulatory target sites. These are perfectly complementary to the respective 5'*tsRNA* (tRNA-derived small RNAs), so mutations at precise locations would have been necessary.[39,40] In addition, special mutations would have been needed to produce the proteins involved in the processing steps. All of this would have had to occur during a short evolutionary time slot using far less than 10^{40} mutating organisms.

We mentioned in part 4 that many cases are known of tsRNAs functioning like miRNAs, having perfect seed regions of about 7 nucleotides (plus additional nt patterns necessary for accurate target recognition).

The *tRF* (tRNA-derived fragment) interactions with key proteins of the translation machinery also rely on sequence-specific binding, whether ribosomal proteins or translation initiation factors.[39]

The limit to *four* precise mutations or their statistical equivalent was based on an upper limit of how many organisms could have evolved over 10 billion years. The above examples are found in multicellular organisms with considerably lower N_e than bacteria and a small fraction of the putative available evolutionary time. There is, however, a small mathematical detail we should not overlook. Some of the necessary nucleotides will match the needed position by chance.

There is a 1 in 4 chance per position to produce a base-pairing interaction. For seven positions, about $7 \times 0.25 = 1.75$ nucleotides will be correct by chance. Countering this objection is the high probability that binding to a random mRNA or other partner would be deleterious, downregulating the *wrong molecule* and tying up a reactant needed for the correct function. Therefore, many more precisely located mutations would be necessary to find a beneficial evolutionary starting point which targets only, or primarily, the correct partners.

Examples requiring more than the equivalent of four precise mutations

In parts 1–4 we discussed many chemical modifications and quality control processes. These rely on binding patterns and novel proteins which jointly require more than the equivalent of four precise mutations. Often a unique enzyme is necessary. Protein families are extremely rare subsets in protein sequence space,[41] and obtaining one or more new proteins would have required far more than the statistical equivalent of four precise mutations. We can state this confidently knowing the difficulty of also obtaining stable protein-protein bindings, and to only correct partners. tRNA-type specific ribonucleases (special proteins) are so discriminating they can identify malformed tRNAs and degrade them.

In part 3, quality control mechanisms designed to identify and degrade flawed tRNAs were described. Special protein-based molecular machines are necessary and feedback loops exist. For example, build-up of uncharged tRNAs communicates that protein translation should be slowed down. This is actively executed by inhibiting MEK2 kinase activity and by regulating the translation initiation factor eIF2α.[1]

In part 4, we discussed many processes tRNAs and their derivates are involved in. Under stress or nutrient limitation, the concentration of uncharged tRNA increases. This initiates a biochemical process that slows down translation.[42] We also saw that many tRNAs are involved in other pathways which

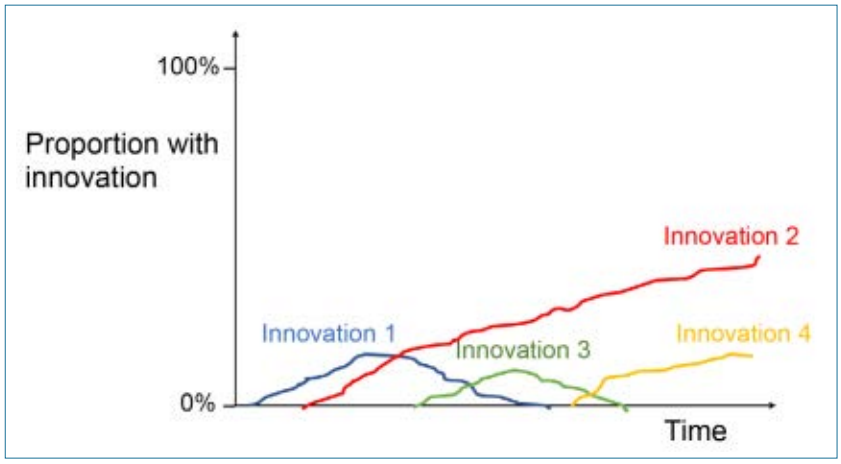

Figure 5. Independent innovations would compete until fixed in a population. Multiple new features are unlikely to arise concurrently in the same individuals. Therefore, evolving innovations would be a zero-sum game. Only the lineages having fastest average reproduction are likely to fix.

are not related to genetic code translation,[43] and for strand transfer during retroviral replication.[43]

tRNAs are also involved in the first step of heme and chlorophyll biosynthesis, are employed as reverse transcription primers, participate in targeting proteins for degradation via the N-end rule pathway[44] (which helps regulate protein concentrations[45]), and participate in regulated cell death (apoptosis).[1]

We also documented that tRNA degradation fragments are not random RNA but carefully crafted by special enzymes which are often tRNA-type specific. These special fragments are involved in cell-to-cell communication, immune signalling, and cell-state transitions. They play a role in suppressing tumour formation and metastasis and can regulate translation by displacing initiation factors. They are involved in modifying chromatin organization, regulating apoptosis and cell growth, maintaining epigenetic inheritance in germ-line cells, suppressing movement of transposable elements, and they interact with the immune system.

We also mentioned in part 4 that higher levels of uncharged tRNAs prevent $tRNA^{Met}$ from being processed by the ribosome. This is beneficial for the cell and occurs thanks to a reliable interaction with GCN2 kinase. From an information processing standpoint, a 'variable' (a specific site on GCN2) is assigned a Boolean value (e.g. 'tRNA is attached'). ('Variables' are implemented by cellular codes using specific binding locations and patterns.[46]) The modified GCN2 then interacts with a specific location on the ribosome eIF2α factor (which is another variable) to phosphorylate it. This inactivates it, thereby preventing the initiator $tRNA^{Met}$ from forming.

At some point in the evolutionary model, various classes of tsRNA fragments would have had to be generated by novel enzymes. These would function in new processes, such as in regulating the concentration of mRNAs and miRNAs, in processes to hinder cancerous growth, and in suppressing metastasis. tiRNAs (tRNA-derived stress-induced RNAs), would also would have had to develop the ability to act as signalling molecules that participate in cell-to-cell communication, in immune signalling, and as biomarkers to detect stress-induced tissue damage.

Also mentioned in part 4, tsRNAs can regulate translation in various ways, for example by displacing translation initiation factors, or by displacing mRNA from the translation initiation complex. A specific fragment, the 18 nt 5′tRF can only affect translation if a specific uridine is first enzymatically transformed to pseudouridine (Ψ). Some tRFs can autoregulate by binding to the aminoacyl-tRNA synthetases involved in producing its parent tRNA.[47,48]

tRFs are also known to be involved in: modifying chromatin organization; regulating apoptosis and cell growth; epigenetic inheritance affecting offspring; suppressing movement of transposable elements; and interaction with the immune system.

Integration of subsystems with multiple cellular processes is often observed in the cellular design. For example, aminoacylated tRNAs (aa-tRNAs) are also involved in non-ribosomal peptide bond formation, post-translational protein labelling, modification of phospholipids in the cell membrane, and antibiotic biosynthesis.[49]

We can only mention here two other mathematical approaches researchers have used to show the inadequacy of evolutionary theory. One approach is to consider the entire 'reservoir' of mutations which could have occurred and demonstrate this is insufficient to explain all biological features which exist.[50,51] We have shown that 10^{40} mutational events could not possibly explain the 'simplest' subsystem of the genetic code.

The second approach considers what Sanford and colleagues call the 'waiting time problem'.[52] The features we mentioned in the tRNA subsystem which require more than 4 precise mutations, or the statistical equivalent, could not have arisen in 10 billion years of evolution, far less all biological features which have existed.

We conclude that evolution is inadequate to explain the existence of a minimally functional ensemble of tRNAs needed by the genetic system, and also inadequate to explain any putative fine-tuning of the processes tRNAs and their fragments are involved in should such an initial state have arisen.

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Ice core oscillations and abrupt climate changes: part 3—large-scale oscillations within biblical Earth history

Michael J. Oard

The Greenland and West Antarctic ice cores show only one ice age. The bottoms of the ice cores show quite warm temperatures, which are expected in the Creation/Flood/Ice Age framework. Because of the bedrock elevation of the sites of the Greenland cores at the beginning of the Ice Age and their distances to warm water, ice did not start accumulating at those locales until about 175 years after the Flood. Those at Byrd and WAIS Divide delayed until about 200 and 300 years, respectively, because of their initial bedrock altitudes. The bedrock elevations for the ice core locations on East Antarctica were above 900 m and so ice started accumulating within 50 years of the Flood. It appears that the bottom 1,500 m of ice on East Antarctica built up within 200 years of the Flood with an accumulation rate of about 10 m/yr. Comparing this rate with snowfall analogues today shows that 10 m/yr is consistent with the unique climate conditions of Antarctica and the warm ocean water offshore. The deuterium isotope oscillations, and all the variables correlated to it, can be explained by decadal volcanic peaks and lulls in the Southern Hemisphere for the first 200 years. Two pieces of evidence show that the ice sheets built up quickly not that long ago.

The Antarctic[1] and Greenland[2] Ice Sheets formed after the Flood, building up especially during the post-Flood Ice Age. How do creation scientists explain these ice sheets, especially the difference between the East Antarctic Ice Sheet and the other two ice sheets? This part 3 will offer an explanation for the large-scale features and correlated variables, while part 4[3] will delve into the explanation of the 'millennial-scale oscillations'.

Greenland and West Antarctica ice cores show only one ice age

The Greenland ice cores (see part 1, figures 11 to 14)[1] mainly show only one ice age. It is the same on the West Antarctic Ice Sheet. The Byrd ice core (part 2, figure 2) shows one ice age while the WAIS Divide ice core shows only about half the Ice Age. The bottom 300 m of these ice cores have been variously interpreted. The oxygen isotope ratio in the bottom fluctuates considerably.[4,5] Scientists were quick to claim that the bottom of the GRIP ice core was from the 'previous interglacial', the Eemian in Europe and the Sangamon in North America. Dansgaard *et al.* even dated the GRIP ice core to 250,000 years (within their uniformitarian worldview) showing not only the previous interglacial, but also the previous glacial and interglacial, based on oxygen isotope fluctuations![6] And the previous claimed interglacial also had abrupt climate changes,[7] which would suggest that the present climate could have abrupt changes also (see part 4).[3]

However, it was later discovered that the bottom 10% of the GRIP ice core was disturbed and therefore they could only date it to about 110,000 years, the beginning of the 'last' ice age within their paradigm.[8] It is readily admitted that the nearby GISP2 core has disturbed bottom layers also.[9] It was deduced that the bottom 10% of the two ice cores were deformed and mixed as the ice sheet moved. Such deformation in the centre of the Greenland Ice Sheet with its cold bottom temperatures, colder than the pressure-melting point, was a surprise: "their occurrence hundreds of metres above the bed in the central region of an ice sheet has surprised many workers."[10] The reason for such deformation is unknown. Therefore, the dating is now considered reliable only to about 105,000 years,[11] although the GISP2 ice core is claimed to have annual layers dated to 110,000 years.[1] Oxygen isotope changes near the bottom of the cores do not represent abrupt climate changes, but deformation. However, the oxygen isotope ratios in some of the deformed ice do indicate temperatures about 5°C warmer at the beginning of the 'last' ice age.

Because of the disturbed bottom few hundred metres of ice in GRIP and GISP2, European scientists drilled NorthGrip (NGRIP) (part 1, figure 1)[1] about 325 km north-northwest of the GRIP ice core. They believed that the bottom of the Greenland Ice Sheet was well below freezing.[12] Thus, the glaciologists expected undisturbed Eemian interglacial layers

above bedrock.[13] They were surprised to find that the bottom of the ice core was melting at 7 mm/yr, and that the Eemian was mostly missing. Because of melting, the bottom ice on flat bedrock was not disturbed, although mysterious, large 200 m amplitude folds, based on radio-echo layers, occur.[14] They dated the bottom to 123,000 years ago, the very end of the 'previous interglacial' and the beginning of the 'last' ice age. The beginning of the last ice age did not begin with an abrupt cooling, just a gradual cooling to about 119 ka with abrupt warming at 115 ka during the Ice Age, which was the time of a strong Milankovitch radiation *minimum* at 65°N.[15] This is the opposite of what should have occurred if the Milankovitch theory were true and their dating correct.

European scientists were anxious to find Eemian ice to better understand interglacials, such as the Holocene. They then drilled another deep ice core to the bedrock, north-west of NGRIP, abbreviated NEEM.[16] The bottom of this ice reached what they believed to be the Eemian interglacial at 128,000 years ago, although the bottom ice was disturbed and folded. During this supposed interglacial, researchers claimed that the temperature at which the ice was deposited was about 8°C warmer than today.[17] The researchers considered that this temperature was caused by a much warmer previous interglacial than today's interglacial, which, like before, provides fuel for the global warming scare. Climate models do not support such warm temperatures, and these high oxygen isotope ratios have been called a 'paradox'.[17]

The large-scale plots of oxygen isotope ratios with depth in the Greenland and Byrd ice cores show warmer beginning temperatures, just before the single post-Flood Ice Age, as expected in the biblical Ice Age model. But in their paradigm, such warm temperatures are a mystery to them. Because the bedrock where GRIP, GISP2, NGRIP, NEEM, and Camp Century were drilled would be of relatively low elevation right after the Flood with a surrounding warm ocean, these areas would not glaciate for a while. The mountains of Greenland would glaciate right away, but the lowlands probably glaciated 100–200 years after the Flood (see part 1, figures 17 to 19).[1]

How are the East Antarctic ice cores explained?

The deep ice cores drilled on the East Antarctic Ice Sheet are much different from the Greenland and West Antarctic ice cores. How are the large oscillations in deuterium isotope ratio and the claimed old ages to be explained? Based on methane correlations of the ice cores between the hemispheres, it looks like the top 1,600 m of the East Antarctic ice cores correspond to the whole depth of the ice cores on Greenland and the Byrd ice cores. So, it appears that the bottom approximately 1,500 m of ice in the Dome C, Vostok, and Dome F ice cores formed *before* the other ice two ice sheets began. This seems to be the only logical way to explain the deeper part of the East Antarctic ice cores, which implies very heavy accumulations early in the Ice Age. How heavy?

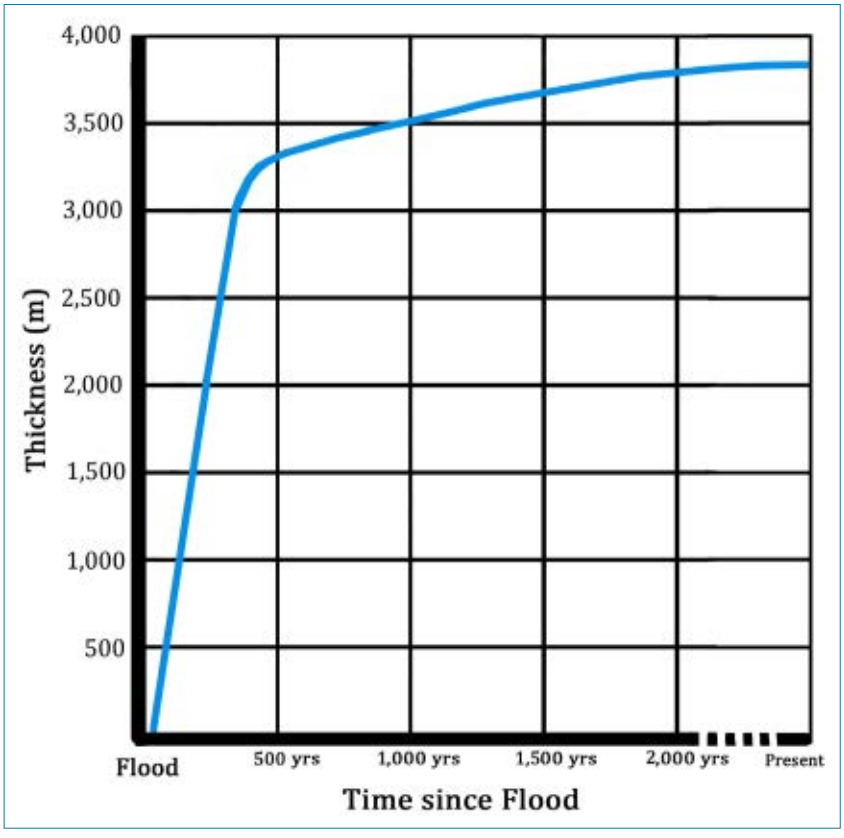

Figure 1. Ice thickness increase with time for the Dome C ice core within biblical history. Note the very rapid rise within about 200 years.

I will focus on Dome C, since it is claimed to have eight glacial/interglacial oscillations. If ice began to accumulate at the location of Dome C soon after the Flood, then 1,500 m of ice had accumulated up to 100–200 years before the start of the Greenland and West Antarctic Ice Sheets. Thus, 1,500 m of ice built up in at most 200 years for an average accumulation of 7.5 m/yr. If the difference in timing between the start of lowland Greenland accumulation and East Antarctica

accumulation was less than 200 years, the ice accumulation rate would be larger than 7.5 m/yr. But including thinning by the weight of ice above for 4,500 years, the accumulation rate was probably around 10 m/yr or more (figure 1). Note that 10 m/yr is an average with more thinning the deeper in the ice. So, the ice accumulation rate could have been near 20 m/yr at the very start of the Ice Age, tailing off to around 5 m/yr within 200 years. It also means that most of the major changes in the deuterium isotope ratio occurred within the first 200 years of the Ice Age on East Antarctica. Is this possible?

In the biblical Ice Age model, the Antarctic Ice Sheets started on the high terrain. Cirques, bowl-shaped amphitheatre-like depressions seen in the mountains by ice-penetrating radar, are evidence of mountain glaciation that also occurred at the beginning (figure 2). Such cirques imply quite warm temperatures at lower elevations:[18] "We found maximum, minimum and average coastal temperatures of 27.8°C, 16.3°C, and 21.6°C."[19] These numbers were projected downward from 2.4 km by assuming cirque temperatures at about 4°C during the start of glaciation and using a standard lapse rate for high latitudes. The lapse rate is the rate of cooling as the altitude increases. Such warm temperatures are unheard of for Antarctica, but they are expected in the biblical Ice Age model, due to the warm ocean water surrounding Antarctica. The offshore temperature could have been as high as 30°C, the average assumed for the whole ocean at the beginning of the Ice Age.[20]

Because of volcanic aerosols high in the atmosphere and the fact that Antarctica straddles the South Pole, temperatures over the higher land would have quickly fallen below freezing and glaciation likely would have begun within 50 years. With the cold air over Antarctica adjacent to a warm ocean, a very strong horizontal average temperature difference was likely present near the coast. By the thermal wind equation, the strongest winds aloft would have been above the strongest horizontal temperature difference. Thus, the storm tracks would be just offshore of Antarctica early in the Ice Age (figure 3). Numerous storms would continually move east around Antarctica, generally in a circle at about 65°S latitude.

Because West Antarctica was about half ocean and half mountains early in the Ice Age, the main storm track would have sometimes passed through West Antarctica. Once West Antarctica was totally glaciated, the main storm track would have become nearly circular. As the Ice Age progressed, the average storm track slowly shifted from 65°S, northward into middle latitudes by the Antarctica Ice Age maximum. The storm track occasionally dipped further northward to produce ice caps on the Andes Mountains, the mountains

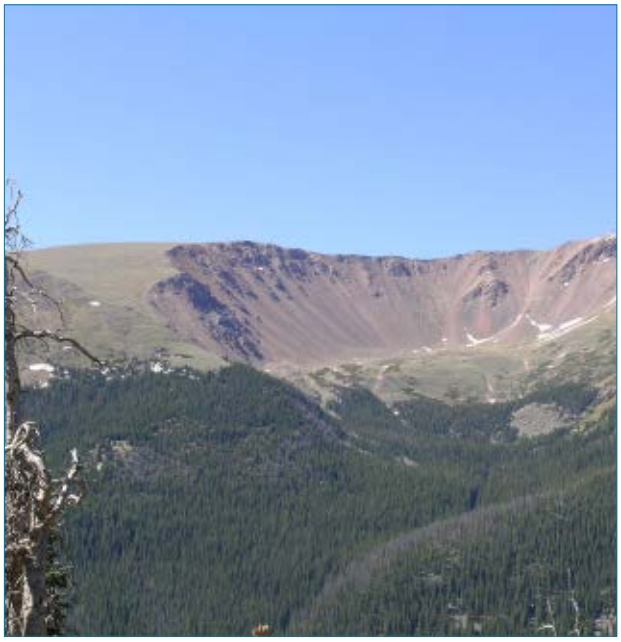

Figure 2. Cirque formed during the Ice Age in the Colorado Rocky Mountains

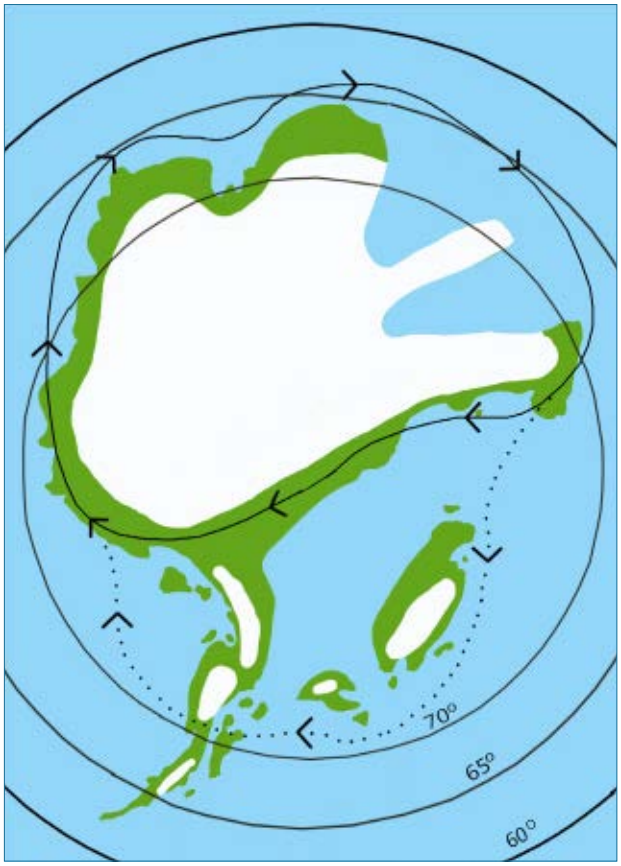

Figure 3. Postulated major (solid line) and minor (dotted line) storm tracks around Antarctica early in the Ice Age (drawn by David Oard and enhanced by Melanie Richard)

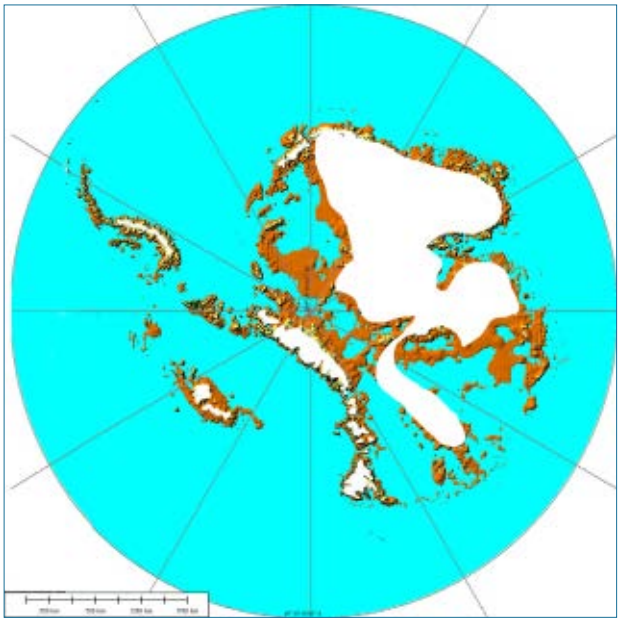

Figure 4. Postulated snow and ice on Antarctica after 50 years (by Melanie Richard)

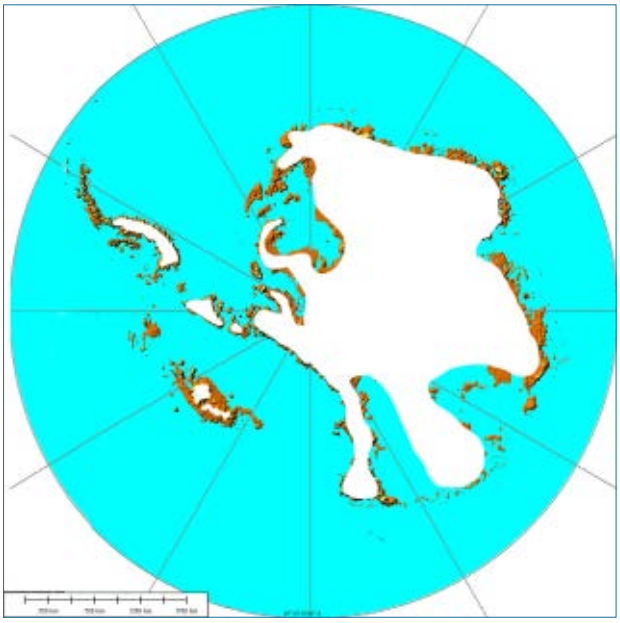

Figure 5. Postulated snow and ice on Antarctica after 100 years (by Melanie Richard)

of New Zealand, Tasmania, and the highest mountains in south-east Australia.

The cold air in the storms would have come from Antarctica and picked up abundant moisture just offshore. Such warm offshore temperatures would have been slow to cool because of the larger ocean/land distribution in the Southern Hemisphere, and the cold air to cool the ocean would have come mainly from Antarctica. The highest precipitation in a storm was in the cold sector, mainly over Antarctica. Therefore, the snow and ice on Antarctica accumulated rapidly. Figures 4 to 9 show the postulated snow and ice accumulation on Antarctica for 50, 100, 200, 300, 400, and 500 years after the Flood, respectively, assuming the same bedrock heights as today with no correction for isostatic effects.

Figure 6. Postulated snow and ice on Antarctica after 200 years (by Melanie Richard)

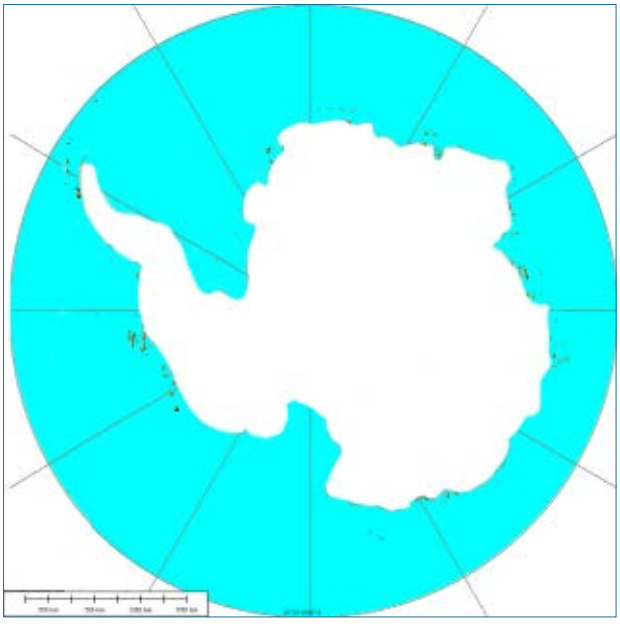

Figure 7. Postulated snow and ice on Antarctica after 300 years (by Melanie Richard)

Table 1. The average precipitation and snowfall at Paradise Ranger Station at the 1,646 m level from 1916 to 2016 in metres

Month	October	November	December	January	February	March	Total
Precip.	0.25	0.41	0.46	0.44	0.31	0.30	2.17
Snowfall	0.7	2.1	3.0	3.3	2.4	2.7	14.2

Present-day snow records

Could East Antarctica have sustained an average ice accumulation of 10 m/yr for about 200 years? Comparing the snowfall at some locations around the world today may help us visualize that this accumulation rate is possible under the unique post-Flood Ice Age climate.

The greatest average snowfall in the world, year after year, occurs in north-west Japan in winter. The lower elevations receive about 6 m/yr and the higher elevations over 13 m/yr of snowfall (figure 10).[21] The Cascade Mountains of western Washington State, USA, receive nearly the same snowfall. The world record snowfall is Paradise Ranger Station, Mount Rainier, in Washington State, which received, from February 19, 1971, to February 18, 1972, 31.1 m of snowfall.[22] Snowfall is not the same as snow depth, which represents the compressed snow.

The high snowfall in Japan is caused by cold, dry winds coming from Siberia, blowing over the Sea of Japan, and picking up abundant moisture that slams into north-west Japan. The mechanism is similar to the lake effect snowstorms around the Great Lakes of North America, but in the case of Japan, it is a sea effect. The winter sea surface temperatures in the Sea of Japan are not conducive to great evaporation, ranging from about 3°C close to Siberia to 12°C near the north-west coast of Japan in December, cooling to 1°C near the north-west coast of Siberia to about 8°C off Japan by the end of the winter.[21] Snow for the Washington Cascade Mountains comes from mid-latitude winter storms with a sea surface temperature off the Washington coast around 8–12°C.

The average snowfall and precipitation at Paradise Ranger Station at the 1,646 m level of Mount Rainier from October to March, the period of the main accumulation, is shown in table 1.[23] A small amount of this precipitation is rain, but with a snow cover it would mostly be added to the water equivalent of the snow pack.

The situation would have been similar though different over Antarctica and the surrounding ocean compared to Japan or Washington state. The meteorological dynamics over Antarctica were similar for north-west Japan in that cold air

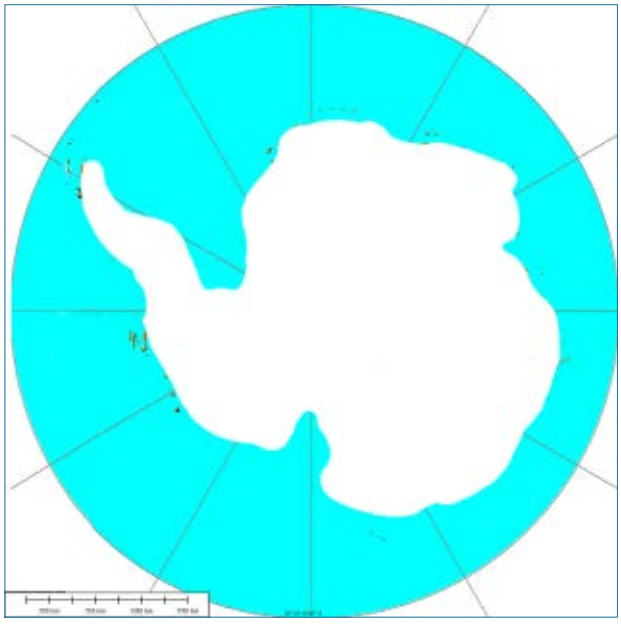

Figure 8. Postulated snow and ice on Antarctica after 400 years (by Melanie Richard)

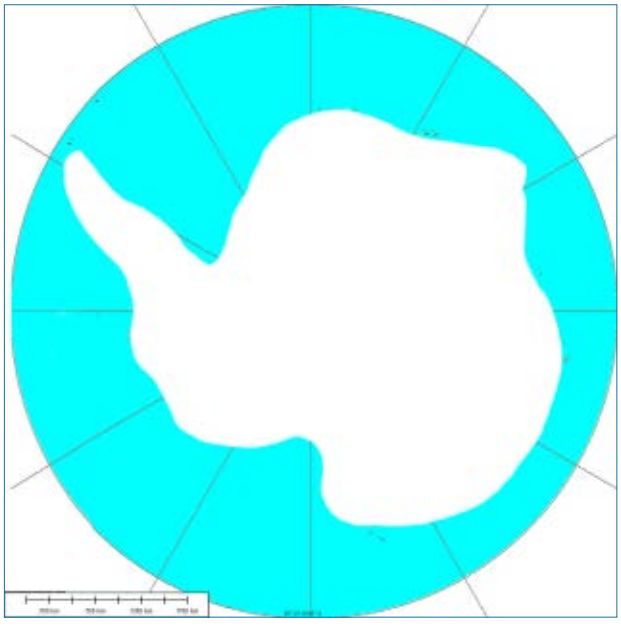

Figure 9. Postulated snow and ice on Antarctica after 500 years (by Melanie Richard)

Figure 10. Snow walls on Tateyama Kurobe Alpine Route, Japan, that connects the Japanese municipalities of Tateyama and Omachi

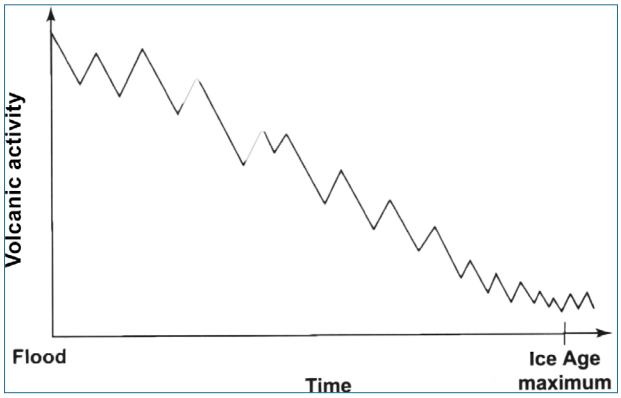

Figure 11. Postulated Ice Age volcanism with peaks and lulls in general decreasing activity with time to glacial maximum[39]

from Antarctica would have blown out over the ocean and caused rapid evaporation. One difference is that Antarctica would have received snow all year around, while it snows at Mount Rainier for only about half a year. So, if the precipitation were the same in the summer six months at Mount Rainier as the winter six months, the total precipitation in water equivalent would be 4.34 m, which amounts to 4.72 m of ice accumulation. The record year at Mount Rainier with 31.1 m of snowfall would have been close to 10 m/yr of ice accumulation. Another difference is the sea surface temperatures off Antarctica would have been much warmer than the Sea of Japan and the Pacific Ocean off Washington state in winter. The warmer the water, the more the evaporation.

Decadal volcanic oscillations can explain the major ice core oscillations

I consider that the deuterium oscillations in the first 200 years of the East Antarctic Ice Sheet were caused by decadal oscillations of volcanism during the post-Flood Ice Age (figure 11). The large-scale deuterium isotope fluctuations likely occurred in one or two decades with ice accumulation rates of 10 m/yr in the bottom 1,500 m of the East Antarctic ice cores. During periods of high volcanism in the Southern Hemisphere, low deuterium isotope ratios likely were produced and vice versa for lulls in volcanism. The climatic effects of each hemisphere are semi-independent with tropical eruptions spreading into both hemispheres.[24] But extratropical eruptions produce 80% more cooling than tropical eruptions, and the aerosols mostly remain in that hemisphere.

There are more deuterium oscillations at Dome C and Dome F than in the Greenland and Byrd ice cores because East Antarctic ice cores started building quickly after the end of the Flood. But Vostok started later than Dome C and records only four 'glacial/interglacial oscillations' because the Vostok ice core was drilled over a large deep lake, delaying ice build-up.

The variables correlated with isotopic ratios

How are so many other variables correlated to the isotopic ratio fluctuations, such as calcium, sodium, methane, carbon dioxide, and dust (see part 2, figure 8)? During enhanced volcanism, more sunlight is reflected back to space causing colder continental temperatures. Colder air blowing out over the warm oceans increased the cooling rate of the ocean surface, causing more evaporation and vertical motions in the oceans. The colder the sea surface temperature, the more the absorption of CO_2 occurs, since there is an equilibrium balance between the atmosphere and the surface layer of the ocean. Furthermore, volcanic ash and dust contain iron, which is a major limiting factor for plankton growth in most of today's oceans. After the Flood, the combination of stronger upwelling and the addition of iron from volcanism likely resulted in great phytoplankton blooms. The phytoplankton are at the bottom of the oceanic food chain and take in carbon dioxide. As these organisms die, they sink to the bottom, taking the carbon dioxide with them. This is called the biological pump.[25] This would have depleted the surface layer of CO_2 causing more absorption of CO_2 from the atmosphere.

Colder air temperatures after the Flood resulted in greater wind velocities, which picked up more continental dust, as measured by the higher calcium ion concentration. Strong winds over the oceans would have picked up more sea spray with more sodium ions ending up in the atmosphere.

Although there are many sources, methane in ice cores likely came from tropical and polar wetlands. The addition of methane to the atmospheric is correlated to temperature. Methane oscillates by about 200 to 400 ppbv and is anti-correlated with deuterium isotope ratios in the East Antarctic ice cores.[26] That is because during intervals of low

deuterium isotope ratios, indicative of cooler temperatures, less methane enters the atmosphere from the wetlands and vice versa with high deuterium isotope ratios.

Evidence of the rapid build-up of the ice sheet

There are several indicators that suggest the ice sheet built up rapidly. The most powerful indicators are the little amount of erosion of the mountains and thick volcanic layers.

Little erosion in the mountains

One indicator of rapid ice sheet build-up is that little erosion is evident on the mountains below the ice. For instance, the Gamburtsev Mountains are located below the centre of the Antarctic Ice Sheet and are about 1,200 km long, about the length of the European Alps. A recent airborne radar survey, completed in early 2009, penetrated through the ice and showed isochronal ice layers, likely caused by volcanic acids, and the basal topography beneath the ice. The remote sensing data revealed a jagged mountain landscape with sharp peaks and high relief, similar to the Alps.[27] The relief averages 2.25 km but is up to 4 km along the edges of the mountain chain. The radar survey exposed a major problem: the mountains showed little evidence of glacial erosion:

> "Reporting this week in the journal Geophysical Research Letters, an international team of scientists describe how they were surprised to discover that the Gamburtsev Subglacial Mountains show little sign of erosion, and that its saw-toothed towering crags resemble the modern ranges like the European Alps or Rocky Mountains."[28]

If the ice sheet was millions of years old, there should be abundant evidence of ice-sheet erosion. This calls into question the age of the ice sheet.

The researchers attempt to claim that the ice sheet has been cold-based so that little erosion would have occurred. The ice sheet is not cold-based today, so why should it be cold during the 14 Ma it supposedly has been thick? During build-up supposedly 34–14 Ma ago, the ice likely would have been warm based. Besides, the Gamburtsev Mountains supposedly existed over 100 Ma before the Antarctic glaciation,[29] so should have been well eroded by weathering, fluvial erosion, etc. Although secular scientists are searching for explanations, the direct implication is that there has not been enough time to erase sharp peaks.[30]

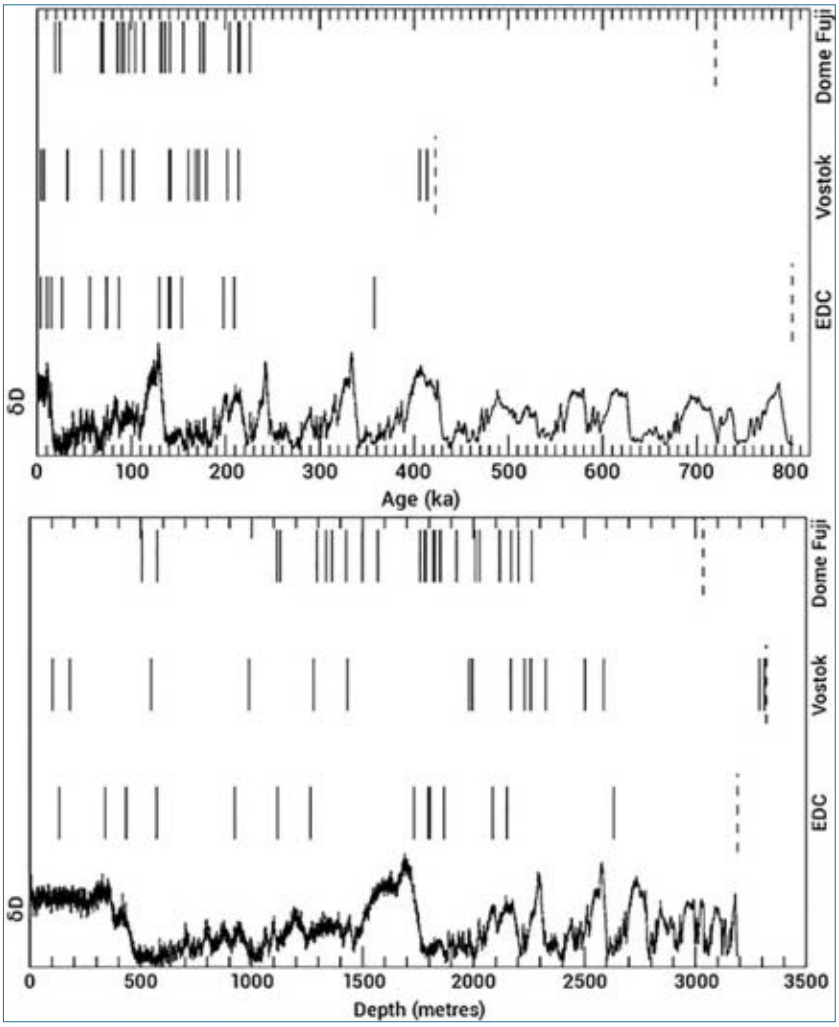

Figure 12. Tephra layers in the Antarctic Dome Fuji, Vostok, and Dome C cores, along with the deuterium isotope ratios from Dome C, as a function of uniformitarian age assignment (above) and depth (below) (courtesy of Jake Hebert of ICR). Dashed lines indicate greatest approximate ages/depths of core sections that were inspected for tephra layers. Dark tephra bands indicate multiple, closely spaced tephra layers. Not shown are two 'extraterrestrial' dust layers between 400 and 500 ka in the Dome Fuji and EPICA Dome C cores.

Thick volcanic layers

When we analyze tephra layers in the East Antarctic ice cores, plotted with depth, we see very few layers in the bottom 1,000 m.[31] Since the bottom 1,000 m in the deep ice cores represents much more time in the uniformitarian model,

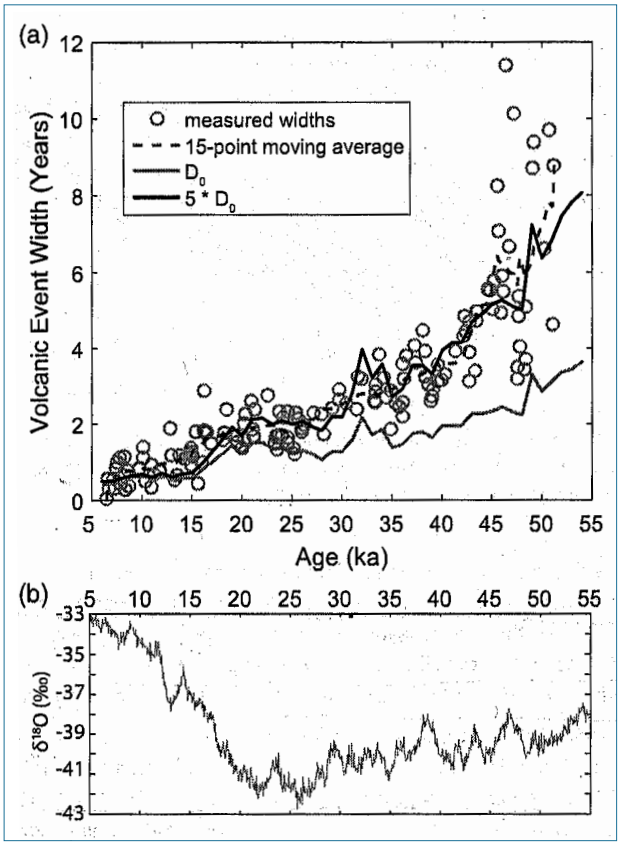

Figure 13. Measured widths of volcanic events converted to years based on thickness of volcanic acid layers (a) and the oxygen isotope ratio in per mil (b) for the Wais Divide ice core to 55 ka[40]

than the ice above, the tephra layers show a near absence of volcanism reaching the ice sheet from 800 to 200 ka. There is an abundance of tephra layers from 200 ka to the present (figure 12). This makes no sense if each major deuterium isotope oscillation represented a separate ice age of 100 ka long. These observations make more sense when we place the tephra layers into the rapid, early build-up of the East Antarctic Ice Sheet in the biblical Ice Age model.

Jake Hebert of the Institute for Creation Research has also documented the stretched-out timescale of the Greenland cores from a PBS show featuring Bill Nye examining a Greenland ice core.[32] Nye noticed a tephra layer at about the 27,000-year level that spanned, unbroken with no gaps, 15–17 years. Another tephra layer in GRIP and GISP2 from a volcano that erupted about 10,300 years ago was spread out over seven 'annual layers'.[33] Volcanic eruptions are usually quick and rarely last more than a year. It is more logical to conclude that the uniformitarian interpretations of the ice cores greatly exaggerate the amount of time.

In the GRIP core, two cryptotephra layers at depths of 1727.75 m and 1734.00 m could not be distinguished geochemically.[34] The 6.25 m of ice separating these two cryptotephra layers corresponds to 106 years within the uniformitarian timescale. It is unlikely these were two separate eruptions, indicating much faster ice deposition.[35]

The stretched-out timescales of the Greenland and Antarctic Ice Sheets is also shown by chemicals that can be traced over multiple 'years'. Such features show up with acids, presumed derived from volcanism. It was noted that the WAIS Divide core could be correlated to the timescale on East Antarctica by a 150-year-long acid deposition event.[36] In fact, it is generally observed that the measured widths of volcanic acid bands in years increases with depth in the WAIS Divide ice core (figure 13).[37] The same broadening unexpectedly occurs with depth in the Dome C.[38] Uniformitarian scientists assume that the explanation for the thick acid layers is diffusion in the ice, but that cannot be the case for tephra that does not diffuse.

Conclusions

The Greenland and West Antarctic ice cores show one ice age that started with warm temperatures, just as expected in the Creation/Flood/Ice Age model. Based on the elevation of the bedrock below the ice cores at the start of ice build-up, it is estimated that the ice did not develop in the ice core locations in the lowlands of Greenland until 150–200 years after the Flood. That is because of their low elevation and because Greenland was surrounded by *warm* ocean water. Also, Byrd and WAIS Divide did not start accumulating ice until 200 and 300 years, respectively, after the Flood. On the other hand, the deep ice cores on East Antarctica likely started accumulation within 50 years of the Flood. This difference in timing likely explains the bottom 1,500 m of ice accumulations on East Antarctica with supposedly about 600 ka of deuterium isotope fluctuations due to differential volcanic dust loading in the Southern Hemisphere. The unique Creation/Flood/Ice Age model provides a solution to this rapid ice build-up with warm ocean water adjacent to a cold continent that straddles the South Pole. It can also explain the other variables correlated to the deuterium isotope ratios. The snowfall over north-west Japan and the Washington Cascade Mountains are a partial analogue for such rapid accumulation of ice on East Antarctica. A number of objective indicators indicate rapid deposition of ice: (1) the little erosion over the Gamburtsev Mountains, and (2) the thick tephra and volcanic acid layers in the ice cores.

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Thoughts on creation: 1— pre-Fall designed outcomes of biological interactions

Warren Shipton

A definition of life is proposed that enables plants and single-celled photosynthetic organisms to be considered life-possessing in both biological and biblical terms. The considerable emphasis given to seed-bearing plants in the first chapter of Genesis is taken as pointing readers to understand the ecological interactions enjoyed by seed-bearing plants, single-celled photosynthetic, and other such organisms in the beginning. Exploration of the likely pre-Fall interactions involving these organisms is made. This provides substantial answers to population control issues when considered together with regulatory rules likely to have operated then. In the absence of destructive competition, carnivorism, parasitism, and environmental disturbances, reproduction would have fulfilled its purpose in some organisms once the earth was filled.

The parameters accepted as defining life impact attitudes and theories dealing with the discovery of extra-terrestrial life, contraception, abortion, whether death occurred before Adam's sin in Eden, and other phenomena. Among Christians, opinions differ regarding what biological entities can be regarded as living based on biblical word studies. The words soul (*nephesh*), flesh (*basar*), blood (*dam*), spirit/wind (*ruach*), and life (*ḥāyâ*; plural–*ḥayyîm*), as used in the Bible, have been taken to indicate the key characteristics shown by organisms possessing life. Hence, vertebrates and invertebrates are held to show the basic characteristics of life (consciousness, capable of pain sensation, air breathing, and possess flesh and blood in some form), but the terms are never used to refer to plants. Hence, plants do not possess life in the biblical sense. This allows the conclusion to be reached that no death occurred in Eden before Adam's sin, even though plants were designated to be eaten.[1]

Another approach is to interpret the terms used above (particularly consciousness, ability to communicate and feel pain) to mean that only those creatures with these characteristics were subject to death as a consequence of the Fall. Hence, insects could have died biologically from the start, for they do not have the capacity to feel pain or to be self-aware. For some, this still leaves plants classified as non-living.[2] It is evident, then, that conclusions differ among creationists, leaving individuals in a somewhat unhelpful position when speaking to those who do not believe in the Bible. It fails to provide what some would consider a coherent account to answer evolutionary speculations. In order to answer some of these issues, the concept of life is considered, and suggestions are made as to the most likely ecological principles operating in the beginning.

Characteristics of life and living things

Among scientists, living organisms are considered to show various characteristics. They possess cellular organization (the genome may be minimal), have metabolic potential (anabolic and catabolic abilities), respond to stimuli, possess homeostatic mechanisms and adaptive capability, and are capable of autonomous reproduction. In reproducing new cells, the metabolic machinery needs to elaborate more of the fundamental material making up the organism. This means that an increase in size or numbers occurs.[3]

When applying the criteria many scientists use to identify life, it is evident that a single cell (e.g. a spermatazoan) or a single animal that is capable of reproducing through sexual means (e.g. a lone mouse) does not exemplify life, even though it is alive. All attempts to define life have encountered similar problems.[4] This was brought into focus in attempts to identify the existence of life elsewhere in the cosmos. In order to remove some of the difficulties, the following definition was suggested by NASA: Life is a "Self-sustaining chemical system capable of Darwinian evolution". This definition does not allow for design and purpose in life. The use of the word 'system' is meant to accommodate a cell or one member of a breeding pair. By using the words 'self-sustaining', the formulators of the definition deny involvement from outside agencies or intelligences for the continuance of the system's operation. Proponents of Darwinian evolution assert that an organism that is considered alive contains a genetic system that replicates imperfectly. The introduced differences are heritable, so the replicates vary in their fitness.[5]

The definition proposed by NASA scientists discounts the possibility of immortality as it does not allow for a sustaining role by God or for the existence of a soul. More seriously for some evolutionary biologists, the identification of defect sequences in DNA and their elimination through technological manipulation is viewed as a move to goal-driven change rather than allowing random forces free expression, which is the supposed hallmark of evolutionary change.[6] This means that despite much effort no entirely satisfactory definition of life has been generated to satisfy modern scientists.

A definition of life on Earth appropriate to this article might be: *Life is the property of any entity that possesses a chemical/biochemical system holding a genetic code that enables it to fulfil its original design functions and to enable it to operate under changed conditions.* This definition acknowledges that life came by design and has purpose. It recognizes the centrality of a genetic code, the existence of a vast array of organisms, and the possibility of immortality on the one hand and of a more restricted existence on the other (e.g. plants consumed for energy generation). It also allows for adaptive changes as postulated in mediated design that permits a complex feature to appear as conditions change. Mutations and other copying mistakes were not a part of the God-instituted strategy pre-Fall; they appeared as a consequence of the Curse.[7] A good example of mediated design is the ancient derivation of today's cereal crops from wild plants through artificial selection involving mutations in regulatory genes or coding genes.[8]

Status of plants and single-celled organisms

The biblical assurance is that God created all things whether visible or invisible (John 1:2–3; Colossians 1:16; Hebrews 2:10). Brief details are given in Genesis 1 covering the life forms (possessing cellular features) made to inhabit the waters, air, and land. If a broad collection of texts is consulted, both animals and plants can be considered as representatives of life. Several texts relate animal life and death to plant functioning, senescence, and cessation of existence. This allows the deduction to be made that if equivalence exists in senescence and death, then both groups are representatives of life. Notice: "My days are like a shadow that lengthens, and I wither away like grass" (Psalm 102:11, NKJV); "For they shall soon be cut down [evildoers] like the grass, and wither as the green herb" (Psalm 37:2). In these verses the Psalmist likens the fate of all flesh and evildoers to the fate of withering/cut grass—they die. Hence, they both surely were alive previously. Job offers an excellent account of trees possessing life and yet subject to frustration of purpose (Job 4:7–10).

> "For there is hope for a tree, if it is cut down, that it will sprout again, and that its tender shoots will not cease. Though its root may grow old in the earth, and its stump may die in the ground, y*et* at the scent of water it will bud and bring forth branches like a plant. But man dies and is laid away; indeed he breathes his last and where *is* he?"

Other texts also reinforce the idea that plants are living things. Notice the following: "For no sooner has the sun risen with burning heat than it withers the grass; its flower falls, and its beautiful appearance perishes. So the rich man also will fade away in his pursuits" (James 1:11); "Now in the morning [after Jesus cursed a tree], as they passed by, they saw the fig tree dried up from the roots" (Mark 11:20). Thus, the Bible establishes plants as possessing life and being subject to frustration of purpose—they, being part of the "the creation" (Romans 8:19–22), are subject to disease, environmental stresses, and outrageous exploitation. If single-celled cultures of either eukaryotic plants (e.g. callus cultures) or animals (e.g. stem cells) are considered, they are capable of regeneration activity under artificial conditions. Plant cells can regenerate a functioning plant, an appropriate animal stem cell can regenerate an organ, but not an individual. These cells are living.

Seeds are "living" because they have the potential to give rise to future life (they are life-giving), as long as they retain viability and provided they are placed under favourable conditions for germination. The Bible goes further and says in the words of Jesus: "unless a grain of wheat falls to the ground and dies, it remains alone; but if it dies, it produces much grain" (John 12:24). Each seed will, under favourable conditions, give rise to a new plant after the pattern held in it (1 Corinthians 15:36–38). Since the living plant does not arise through spontaneous generation, viable seeds represent life and the future. They have life in them.

Unicellular organisms often could come under the heading of the invisible things spoken of by the apostle Paul (Colossians 1:16). Certainly he was not speaking specifically about microscopic biological entities, but these could be included. Today we know that not all single-celled cells are invisible. *Syringammina*, a single-celled foraminifer genus (in the subphylum Foraminifera—single-celled organisms with a hard external shell), can reach 20cm; and *Gromia*, an amoeba, can grow to 38cm.[9] These sea creatures can reproduce and

Figure 1. Single-celled *Gromia sphaerica* amoeba. Their size can be assessed against the black shrimp. The inset shows individual cells with their mud trails.

the latter is mobile, leaving visible mud trails as evidence (figure 1). *Gromia* in particular, could be included in the Genesis 1 account that speaks of God creating or giving life to "every living thing that moves" (v. 21). We are left in no doubt, then, that single-celled organisms can be classified as life-possessing both biblically and scientifically.

Not all single-celled biological entities can reproduce even though they can metabolize and move. Sperm (Hebrew *zera*) are a case in point. They contain the potential to initiate life when they meet a suitable ovum (*zara*) under ideal conditions. The sanctity of *zera* is noted in Scripture (Genesis 38:9–10), which can be argued as being partly on account of them symbolizing life.

In the plant kingdom, ovules may give rise to offspring through parthenogenesis, a process not requiring fertilization by sperm. Surprisingly, this phenomenon is seen in the animal kingdom as well, being found among invertebrates and a few vertebrates. The Komodo dragon is one reptile that participates in virgin births of males, presumably through the fertilization of an egg by another egg thus allowing doubling of the genes and enabling live young to hatch.[10] This illustrates the difficulty of distinguishing between living and non-living against a check list. According to the proposed definition, these single-sex entities are living.

Ecosystem functioning in the beginning

Both photosynthetic and non-photosynthetic organisms satisfy the definition of life as argued in the previous section. Plants originally were given as an animal food source, meaning that some planned resource utilization and population control (e.g. grazing restricts seed production in grasses and limits photosynthetic resources available for growth) was experienced in paradise. On the other hand, grazing activities (pruning) are known to be beneficial to branch strength and fruit formation in other plants. A return to the original diet will occur in the New Earth. There the emphasis with forms of life other than humans is on the promise that nothing will "hurt nor destroy" (Genesis 1:30; cf. Isaiah 11:8; 65:25; Revelation 21:4).

The ecosystem in the beginning was characterized by the absence of hurtful, destructive activity too. This raises several questions. One is: How are we to view the collection and consumption of plant tissues, fruits, and seeds and the consumption of whole living entities (photosynthetic), such as non-motile diatoms and motile dinoflagellates by sophisticated capture mechanisms? The answer seems to reside in whether an organism can experience hurt (Hebrew *ra'a'*). This word has the meaning of spoiling, breaking in pieces, and to afflict in a physical, social, and moral sense.[11] Affliction in a physical sense involves pain and the development of a negative mental state. The ability to respond to unwelcome stimuli (nociception) is possessed by seemingly all forms of life, even bacteria. Nociception is not pain, for the latter involves the development of negative, internal mental states. It is conceded by experts that most mammals feel pain and this can be extended perhaps to most vertebrates. Higher animals show an altered mental attitude in their efforts to avoid such distressful situations in the future. This change in attitude can be recognized by an alteration in behaviour towards particular stimuli. In simpler animals, various criteria nominated for the perception of pain, based on the human model, are not satisfied. This means they do not sense pain. The situation with most invertebrates is much less clear on the basis of the criteria available to assess whether pain is experienced.[12]

On resource utilization, photosynthetic organisms were designed to fulfil a number of functions which included primary production, forming replicating propagules, and acting as a food source for various life forms. In fulfilling some of these functions, the ingested tissue may perish as such. Hence, partial destruction of material assets was designed to occur among vegetables, grass, and shrubs, and related photosynthesizers, and entire destruction was a possible occurrence with fruits, nuts, and grain (although dispersal by animals was also presumably a design function for some plant propagules). The engulfment of single-celled (photosynthetic) and simple planktonic organisms was surely a planned outcome, for such organisms are at the base of the food chain in aquatic environments. This represented a fulfilment of their design function and is not to be classified in the same category as the destruction coming on account of human disobedience.[13] The latter can encompass such phenomena as debilitation by disease organisms, destructive harvesting of resources for gain, and elimination through human-generated environmental stresses. The organisms mentioned as being harvested according to God's design initiatives do not experience pain. This leads us to consider the likely interactions present in the beginning.

Interactions among organisms

Organisms in any community are linked in complex ways. They are dependent on each other for the transfer of nutrients and energy. All ultimately are dependent on the sun's energy to drive the processes seen in nature. The more complex the pattern of interactions, the more resistant the system is to change. Conserving interaction features are significant to the long-term survivability of ecosystems.[14] Photosynthetic organisms are central to ecosystem functioning and this is inferred in the first chapter of Genesis in that seeds and seed-bearing plants are mentioned six times.[15]

The suggestion is made here that this emphasis points to significant clues regarding ecological principles operating

Table 1. Interactions involving seed of animal and of plant origin considered to have operated in the pre-Fall world (illustrative references only are given)

Type of Interaction	Event	Some Organisms Involved
Primary producers	Organic matter production[19]	Diatoms, dinoflagellates, land plants, sea grasses, sea weeds
Decomposers, detritivores	Degradation of waste materials including dung and the chlorophyll molecule[20]	Bacteria, fungi, protozoa, invertebrates primarily
Commensal	Growth of orchids on trees[21]	Orchids, trees
Protocooperation	Bacteria gain benefits from plant exudates and confer benefits to plant[22]	Plants and bacteria
Mutualism	Germination and establishment of orchid seedlings; photosynthetic zooxanthellae operating inside invertebrate corals.[23]	Orchid seeds and fungi; zooxanthellae and corals
Amensalism	Germinating seeds release allelochemicals[24]	Plants
Competition	Pollination, fusion, and exclusion of gametes in sexual reproduction; response to light and space.[25]	Flowers, mammals, birds; sea weeds, crustose algae
Consumption of eggs	Egg gathering for food[26]	Fish to zooplankton
Consumption of plant material	Herbivory, granivory, and frugivory[27]	Humans, various animals, birds
Consumption of photosynthetic unicells	Food gathering[28]	Ciliates, diatoms, dinoflagellates, zooplanktonic grazers

in the beginning—look at the plants and their characteristic interactions! A related thought may be applied to aspects of animal and human behaviour. The instruction to be fruitful and multiply by means of seed is mentioned frequently or implied elsewhere in Scripture (e.g. Genesis 1:22, 28; 7:3; Numbers 5:28). Hence, it seems reasonable to accord significance to the word translated "seed" associated with the animal kingdom too. Readers might bear in mind that in this paper an attempt is being made to identify the ecological principles most likely to have operated in the world immediately following creation. Changes have occurred since then, an issue that will be addressed partially in a subsequent paper.

Photosynthetic organisms were designed to fulfil a number of functions as indicated above. Photosynthesizers do not possess highly developed sensory systems and certainly do not possess even an elementary nervous system such as seen in insects.[16] A nervous system is necessary for the detection of pain; hence, plants cannot be considered to suffer pain. Plants do have an elementary communication capability (they possess chemoreceptors mechanoreceptors). Plants may generate chemical signals that attract helpful insects, stimulate pheromone production in insects, signal other plants that insect attack is imminent, or release volatiles with biological activity that influence a range of other biotic interactions. Herbivore-damaged plants also are able to release volatiles that repel sap-feeding insects. Communication via chemicals released from roots allows them to signal stress to their neighbours, allowing them to respond appropriately.[17] Mechanoreceptors respond to touch. An electrical signal is generated in response to changes in ion frequencies caused by movement, as in the Venus flytrap.[18]

The spectrum of interactions that photosynthetic plants are involved in is extensive, especially their seeds, and single-celled organisms and their gametes. If we add to this list the interactions and the fate of generative elements of animal origin, the data in table 1 can be assembled. Such information enables us to understand some of the mechanisms operating to achieve population control and stability of the ecosystem (addressed later). The inclusion in the table of the phenomena of amensalism, competition, and phagocytosis (a form of predation in the language of science) requires a little explanation.

Amensalism may be observed during the germination of many seeds. Inhibitory chemicals (allelochemicals) may be released that can inhibit or delay the germination of other seeds, thereby giving the plant a competitive advantage.[29]

This highlights one problem that must be answered in creation ecology. How were populations of organisms restricted in their increase without recourse to hurt? Fortunately, the question does not arise with plants since they cannot sense pain, leading to the acceptance of inhibitory chemical release as a design function. Similarly, there should be no issue with the release of antibiotics and biocides effective against microorganisms that do not possess mechanisms capable of feeling pain.

Continuing with the idea of competition, the phenomenon comes in a number of reasonably innocuous forms in the plant kingdom. In many environments, plants compete for light. In forests, it is observed commonly that those requiring full exposure continue to grow upwards to achieve this while shade adapted species flourish at lower levels. Taking another example, in natural aquatic environments the supply of inorganic nutrients is low. If this was not so, then eutrophication would occur with disastrous consequences.[30] Algal growth is limited by nitrogen and phosphorus, but algae have the capacity to store phosphorus internally. Bacteria are able to take up these nutrients more quickly than algae, hence limiting the latter's growth.[31] We do not place this limitation of nutrients and competition for them in the same category as their availability in soils. In the latter instance, God indicated a diminution in fertility as a consequence of man's waywardness (Genesis 3:18–19; 4:12). In other interactions in the aquatic environment, such as between corals and macroalgae, there is competition for space and light. If the balance of coral-algal competition is maintained then a coral reef remains healthy, otherwise algae overgrow the corals.[32] In cases of limitation of resources, competitive exclusion could lead to total elimination if the population size of one of the competitors is limited. We do not envisage that this was happening in the newly created world.

Competitive phenomena also are observed in plants involving reproduction. Some plants are self-fertile, exhibiting competitive selfing. Here the anthers surround the stigma. On account of the close proximity of these structures, selfing is almost inevitable and this effectively prevents outcrossing. In other words, competition has a mostly one-sided outcome.[33] The final example of competition, which is understood as a design feature by perhaps all, is the sexual act. Some 40 million to 1.2 billion sperm cells are released during this act in humans, yet only one sperm succeeds when a suitable ovum is present. This one sperm is the winner in an intense competitive event.[34]

The case of phagocytosis appears to be a design feature in selected situations. If we take the genus *Alexandrium* in the dinoflagellates, which is both photosynthetic and capable of sexual reproduction, it provides a good example of an organism capable of feeding on diatoms, ciliates, and dinoflagellates via phagocytosis. Again, we can consider the diatoms. They are unicellular, mostly non-motile, sexually reproducing, photosynthetic organisms found in aquatic environments. They are responsible for about 40% of primary productivity. They are eaten by zooplanktonic grazers such as ciliates, dinoflagellates, and copepods.[35] This would appear to be a design outcome if we take terrestrial grazers of sexually reproducing, photosynthetic plants as our guide. Here, instead of eating portions of photosynthetic tissue (as with humans, cattle, and others), the whole organism may be consumed.[36] This means that at the commencement of the food chain in aquatic environments, the participants are involved in consuming other organisms. Since their responses to external stimuli are poorly developed, they appear to be in the same league as grass, fruit, and seed. All these have a primary production function by design and also can be destined for consumption thereby fulfilling a secondary function. In support of the design function concept for phagocytosis of unicells, it might be pointed out that the immune system of higher animals is dependent on the phagocytic activity of special cells to clear the circulatory system of foreign material. Such a system is hardwired in all so-called advanced organisms.

Incidences of phagocytosis (a form of predation) might be taken a little further by considering endo- and exo-cytosis events in humans. For example, reference can be made to communication between neurons via the synaptic vesicle cycle (figure 2). In the case of transmitting nerve signals,

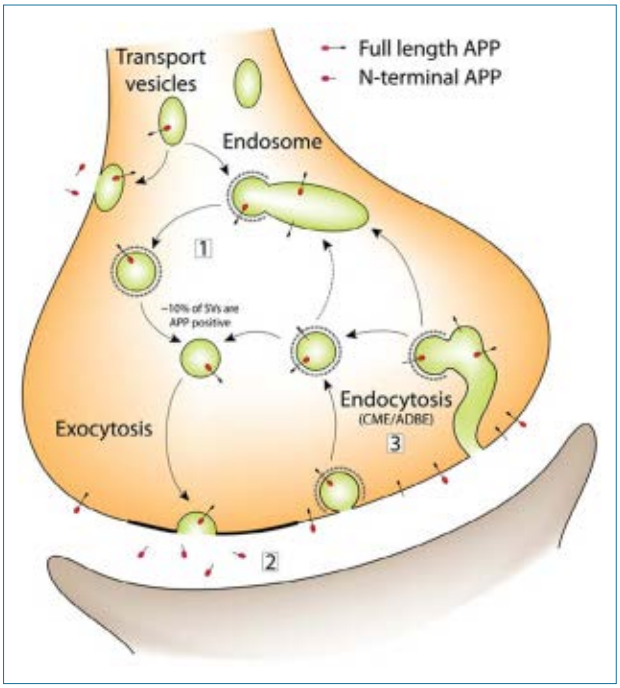

Image: PLoS ONE/ CC BY 4.0

Figure 2. Recycling pathways in the presynaptic terminal possessed by synaptic vesicles. The pathway illustrated is for the amyloid precursor protein involved in synaptic maintenance.[38]

this involves the release of neurotransmitter molecules at the nerve terminal. There vesicles prepare to release neurotransmitters previously taken up internally. This they do by exocytosis into the synaptic cleft. The synaptic vesicles now move on to become involved in endocytosis in order to recycle neurotransmitters. The processes involved are complex.[37]

While the destruction of photosynthetic tissues and organisms and the utilization of generative elements released into the environment as food items can be accepted as design outcomes, the question remains how extensive such utilization arrangements were (e.g. how do we realistically view insect dynamics?). In the present world, feedback loops involving predation, parasitism (in some instances this represents modified mutualism),[39] and competition for resources are significant in population dynamics and hence the stable operation of the ecosystem.[40] Suggestions are made in the next section about the principles that reasonably could be applied primarily to photosynthesizers and their utilizers in the pre-Fall world.

Regulatory rules

In post-Flood ecosystems four principal rules effectively explain population control. These are positive (induction) and negative (repression) regulatory events, indirect effects of one organism on another in a chain of interactions (cascade), and density-dependent or end-product inhibition phenomena. These same rules appear to apply to cellular regulatory events across the spectrum of free-living organisms.[41] Hence, there is no obvious reason why these rules cannot be accepted as being fundamental to life whether pre- or post-Fall. In the examples emphasized in this paper, positive regulation is illustrated (table 1) in mutualism, negative regulation is illustrated under the heading of competition and also amensalism, indirect regulatory effects (cascades) have been demonstrated involving fish, zooplankton, and phytoplankton and other plant/plankton-associated events,[42] and density-dependent phenomena can be shown by intraspecific competition of herbivores for food resources.[43] The examples taken fit comfortably into what is understood about the pre-Fall world. Accepting the assumptions made initially, this means that all four rules can be applied to the pre-Fall world. However, the absence of flesh-eating creatures, disease, and natural disasters means that population increase in the pre-Fall world would have continued uninterrupted, as there was no death. Assuming regional commencing concentrations of animals, birds, and other created moving organisms (without this postulate the advice to multiply would have had limited meaning; compare with human arrangements too), a time would come when the earth was filled. Then, the purpose of reproductive activities would have been fulfilled in some organisms (cf. Matthew 22:30).

Summary

Arguments are presented from Scripture and science enabling plants to be regarded as life-possessing organisms. The emphasis on seeds and seed-bearing plants in Genesis 1 suggests that more attention might be focused on the predominant interactions involving photosynthetic plants and their interactions in the ecosystem in order to understand operating conditions pre-Fall. Plants possess elementary sensory capabilities, but these do not represent perceptions of pain. It is argued that, in the pre-Fall world, they participated in the majority of interactions recognized in today's ecosystems except for parasitism, wholesale predatory destruction, and perhaps competitive exclusion phenomena. These interactions would have enabled ecosystem stability and some population control. However, reproduction in a raft of organisms would have become unnecessary once the earth was filled with their kind and adjustments would have been undoubtedly made by the Sustainer of all things.

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Delta formation in the Kaystros estuary and silting of the Ephesus Harbour within biblical history

Andrew Sibley

This paper highlights research relating to the history of the Kaystros estuary and Ephesus harbour as a 30-metre-deep estuary silted up through several thousand years of recorded history. While secular science extends the period of human settlement to 3000 to 5000 BC, the rate of sedimentation at the earliest times fits better within the biblical timeframe. Human activity likely speeded up rates of sedimentation due to the agricultural requirements of a growing population causing faster soil erosion. But the discontinuity in the secular timeframe is considered excessive, i.e. between the Classical-Hellenistic period and that of previous generations. It is considered likely that carbon-14 was not in equilibrium between the atmosphere and ocean towards the end of the Ice Age, which renders carbon-dating erroneous at the earliest time with a widening margin of error.

As sea levels rose at the end of the Ice Age previously extended river valleys were flooded, forming dendritic estuaries known as 'rias'. Many of these rias subsequently silted up within recorded history. Examples exist from across the world of delta formation: the Rhine and Rhône rivers in Europe, the Ebro river in Spain, the Egyptian Nile, and the Mississippi in the Gulf of Mexico. The geomorphology of delta formation is dependent upon a number of factors, such as relative water density, river flow rates, offshore currents, tidal range, and wave energy. This paper will focus upon the Cayster or Kaystros (Ancient Greek: Κάϋστρος / Turkish: Küçük Menderes) river estuary at ancient Ephesus, located on the coast of western Turkey, much of which silted up within recorded history. Figure 1 shows the location.

The ancient city of Ephesus is well known to Christians from the New Testament. Paul preached there during his ministry (Acts 19), and saw miracles and revival. This was followed by rioting, led by adherents of the goddess Artemis, who were concerned about loss of revenue from the trade in idols. During this time there was a harbour at Ephesus, and the city was the Roman capital in Asia Minor in the time of Augustus (figure 2). But the harbour was slowly silting up. In fact, the harbour and estuary of the Kaystros river had been silting up for many centuries prior to this, and this continued through the Roman and Christian eras. Today the harbour and city that Paul knew are several kilometres inland from the coast (figure 3).

It is evident that coastal margins have changed markedly since the end of the Ice Age, and within the timeframe of human history. Much of this is recorded in written sources, understood through archaeology and examination of the geomorphology. This discussion will highlight ongoing secular research, and show that deposition has occurred within recorded history over centuries, and can be fitted within a biblical timeframe. This points to relatively recent adjustments to the landscape following the Flood and Ice Age epochs.

At the peak of the post-Flood Ice Age, with millions of cubic kilometres of water locked up in ice, sea levels were an estimated 50 m below current levels,[1] and then rose to near current levels as the ice melted. Once the sea level had risen and flooded valleys at the end of the Ice Age, the process of sedimentation began in newly formed *rias*, or marine gulfs. Delta formation in this valley may be classified as a *freshwater tidal delta*, where the river water meets the sea and dendritic-shaped sub-estuaries are formed.[2] Fresh water washes material downstream and deposits it where the tidal ebb-and-flow meets the river flow. The twice-daily tidal hiatus of the river flow causes deposition of suspended material within the estuary, as do periodic river floods. The natural process of deposition of sediment in the flood plain is often accelerated by human activity: e.g. forest clearance for agriculture by a growing population increased the rate of land erosion, and sediment load in the river. This increase in population occurred after the post-Babel communities had spread out and settled in the virgin land.

Historical sketch of settlement at Ephesus

The first human settlers in this area are described as Neolithic and believed to have arrived in the valley around 5000 to 3000 BC by secular science. The Neolithic people are said to have developed settled farming practices through animal rearing and crop plantations, but had not yet developed the skills of metallurgy, which is identified as the later Bronze Age, Iron Age, etc. However, the division of history in this

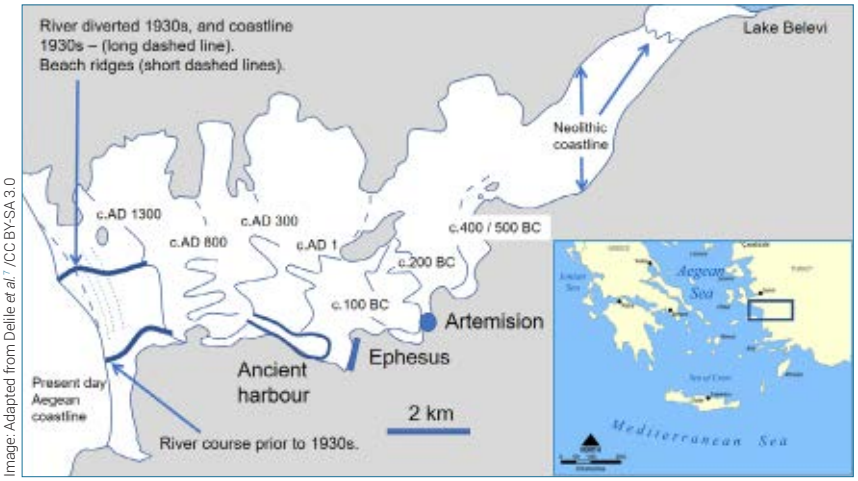

Image: Adapted from Delile *et al.*[7] / CC BY-SA 3.0

Figure 1. Map of the Kaystros estuary / Küçük Menderes Delta as it silted up over time (adapted from Delile *et al.*[7]). Inset is the regional location with box added.

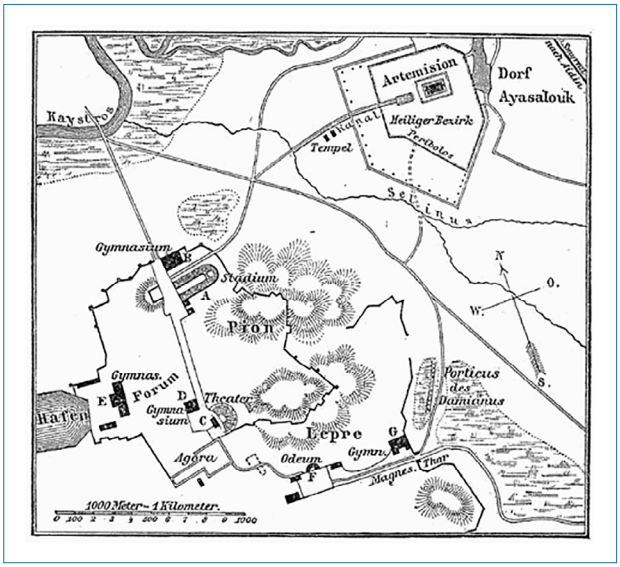

Figure 2. Ancient city of Ephesus in the time of the New Testament. Encyclopedia: Meyers Konversationslexikon (MKL) 1888. This shows the Stadium near the foot of Mt Pion, the harbour bottom left with the city wall running over Mt Pion. The map doesn't show the Arcadian/Harbour Way leading from the Theatre to the harbour. The Artemision is top right. The straighter lines are roads, also note the River *Selinus* running into the *Kaystros* river with marshy land alongside the river. It is written in Greek, Latin and German (Hafen = harbour, Dorf = village).

way is really built on the secular myth of an evolutionary progression and departs from biblical history.

During the second millennium BC the Arzawa kingdom had located its capital at Apasa (Ephesus), later settled by Mycenaean expansion around 1300 BC.[3] The Archaic Greek or Ionic period can be traced from about the 10th to the 6th century BC. The first temple of Artemis (Artemision) was attributed to the semi-mythical Amazons by the Greek poet Callimachus in the *Hymn of Artemis*, although a site of worship probably existed here prior to Greek arrival. This temple, built near the water's edge, was destroyed by a flood in the 7th century BC, and rebuilt by Croesus, the Lydian king around 550 BC following conquest of the city. The location of the temple was to the north-east of Mount Pion (figures 1 and 2). It was later destroyed by fire in 356 BC, and rebuilt again from 323 BC. The Classical Greek period continued from 500 to 350 BC, the Hellenistic period from 350 BC, and the Roman period from around 129 BC. The Byzantine period ran from 395 to AD 1308, followed by the Ottoman era. Archaeological work in the 20th century found the Artemision and access roads covered by 5 or 6 m of alluvial and colluvial material (figure 4).

During the Hellenistic period, the city and harbour were sequentially moved downstream, for example by Lysimachus around 290 BC, with progradation of the estuary. But even the new harbour became difficult to navigate. The Roman historian Titus Livius (63 BC to AD 17) recorded that the harbour entrance at Ephesus in 190 BC was "like a river: long and narrow and full of shoals".[4] Attempts to stop this process of sediment accumulation may have had adverse consequences. Strabo (64 BC to AD 23) noted the further narrowing of the entrance with the establishment of a *mōlēs*, an estuary embankment that separated the river from the harbour, and hindered the "ebb and flow of the tides".[5]

Geomorphology of the Kaystros estuary

The geomorphology, particularly the sedimentary features of the Kaystros valley, has been changing over several millennia, and examined over recent decades through the utilization of core samples, archaeology, and ancient texts, and described in several papers.[6–8] The valley, in which ancient Ephesus resides, is a *graben*, known today as the Küçük Menderes *graben*. The implication is that the valley has been displaced vertically downwards along faults that run parallel with the valley. This region suffers from damaging earthquakes as a result of numerous faults in the region. Such local isostatic changes to the sea level may be several metres over the past few thousand years, with eustatic changes around 1–2 m at the most. Kraft *et al.* suggest a lowering of sea levels of up to 2 m between 1000 and 1500 BC, followed by a steady rise to today's level.[6,8] The surrounding hills are *horsts*, having been displaced vertically upwards.

The Menderes mountain range in this area is formed of hard crystalline metamorphic rocks—identified as Palaeozoic and Lower Mesozoic by secular science—typically gneiss and granite-mica schist, and phyllite, quartzite, and marble. Along with this are Miocene–Neogene softer deposits of marly limestone, sandstone, and clays.[6,8] With uplift and

erosion during the late Neogene/Quaternary, re-interpreted here as the recessional period of the Flood, and with excessive rainfall in the immediate post-Flood and Ice Age period, massive denudation and modification to the landform occurred. At the peak of the Ice Age the lower valley floor was some 30 m deeper than today's level, with the seashore extended westwards and some 50 m below current levels.

At the end of the Ice Age, following associated rises in sea level, the sea encroached some 18–20 km inland along the newly formed ria.[7] The Kaystros valley narrows above Ephesus, and then opens out into a wider plain, part of which was then Lake Belevi—now it is a smaller, shallower marshy lake (figure 1). During the Ice Age this was a freshwater lake, then became brackish as sea water flooded the valley at the end of the Ice Age. As delta progradation began in the Kaystros valley, the lake became cutoff from the ocean and reverted to a freshwater lake once more, but continued to accumulate sediment. Stock *et al.* trace the start of lake sedimentation back to 8,000 years before present, with descriptions of two core samples from near the lake shore.[9]

Kraft *et al.* highlighted delta progradation along approximately 14 km of the valley, through an estimated period of about 5,000–7,000 years (figure 1).[6,8] This is proposed from the Neolithic period, with substantial amounts of alluvial and colluvial deposits subsequently causing the estuary to silt up. Alluvial deposits have been brought down the valley along the river, and colluvial material by the action of gravity, earthquakes, rainfall, and other factors acting on the eroding of the hill sides. Human activity, involving forest clearances and tilling of the soil, may have increased the rate of erosion and deposition as the population grew. Rates of sedimentation are also dependent upon the hardness and consolidation of the bedrock.

Kraft *et al.* estimated that sedimentation was accelerated in the Classical period (400–200 BC) as erosional use of the land increased, followed by a more gradual accumulation through the Roman and Byzantine period, and into the modern period. Their estimation is that an approximate 10 m depth of sediment accumulated between 3000 BC and 400 BC, and 10 m between 400 BC and 200 BC: an approximate ten-fold increase in the rate of deposition (a cross-section is shown in figure 5). However, estimates of population size and growth rates in ancient Greece are varied, with some studies suggesting that the population in this region grew more than ten-fold between 800 and 400 BC, along with colonization of the coastal regions of Asia Minor. But other estimates of growth rates are lower.[10] This does however suggest the feasibility of faster rates of sedimentation prior to 400 BC, if population growth were faster. Through the several-thousand-year period of human settlement, the estuary, over 10 km in length, several km in width, and 30 m in depth, became completely filled in with sediment.[6,8]

The shape of the delta was evidently changeable through the period of progradation, which can itself affect rates of deposition.[11] During the Hellenistic and early Roman period the Kaystros river deltaic sequences displayed typical 'bird's feet' or dendritic distributaries, composed of sand and silt. Rates of sedimentation tend to be faster adjacent to the river channels. As delta progradation neared the open sea, sandy coastal barriers formed by the late Byzantine period. By this time, the harbour at Ephesus was no longer accessible.[12] The river valley now displays typical meanders in the silted-up estuary, with cut-off, oxbow sections. The river was diverted into a canal towards the north of the flood plain in the 1930s, which, from satellite imagery, has evidently altered the shape of the beach with several hundred metres of new beach-front in about 90 years. Current rates of deposition have reduced because of water extraction, and coastal erosion has become a concern.[12]

With focus upon changes to the later Greek and Roman harbour at Ephesus, it can be seen that during the Roman period of Augustus there is evidence that the harbour went through a more rapid period of silting, and a period of anoxic conditions. The cause of this is not clear, but may be related to the construction of the harbour embankment. The rate is estimated at 20 cm/y, or 7 m over several decades, followed by a slower process until becoming dry in the early Middle Ages. The city of Ephesus was fed by a system of aqueducts that washed waste water into the harbour, but various earthquakes may have disrupted this water supply. This may have encouraged the build-up of sediment along with the formation of the embankment.[7]

Radiocarbon dating

Carbon radiometric dating has been correlated with archaeological and written sources by researchers at this location, where available. This helps with validation, as the presence of carbon-14 may be affected by contamination from a number of physical sources.[13] More widely, a comparative correction is normally made to the raw data of samples or artefacts to account for changes in atmospheric carbon dioxide.[14] This is based upon dendrochronology back to 9,000 years before present (BP), although dendrochronology is not without problems: for example, some tree species are known to show multiple growth rings per year,[15,16] or the chronologies are artificially extended through weakly attached crossmatching 'bridges'.[17] At the longer time frame to 25,000 BP correlation utilizes sequences of corals, along with calibration with U/Th dating.[18]

Errors in marine dating are also not easy to iron out. The uptake of carbon in marine organisms, in terms of calcium carbonate to form shells, requires different corrections. It is known for example that some living marine organisms have an apparent age of approximately 400 years.[19] This is denoted as the *marine reservoir effect*: as R(t) = c. 400 radiocarbon years (^{14}C y), which is a global average. But there are regional variations: referred to as ΔR. There are several methodologies used to determine ΔR—e.g. correlation with known age samples that utilize museum specimens, tephra

Image: Jordon Klein. / CC BY 2.0

Figure 3. Distant view of the silted old harbour, looking west from the top of the Ephesus Theatre along the Arcadian Way, which leads to the old harbour. The coast is in the further distance. 8 March 2004.

Image: FDV/CC BY-SA 4.0

Figure 4. Remains of the Temple of Artemis at Ephesus, Turkey. The remains were found under 5–6 m of alluvial and colluvial deposits. 10 June 2017.

isochrones, or the pairing of marine and terrestrial samples near to archaeological locations.[18]

Variation in ΔR may arise for a number of reasons. Ocean water takes longer to mix and reach equilibrium with the atmosphere. Water mixing is dependent upon the water temperature and the salinity, and slower mixing at depth requires thousands of years to reach equilibrium in the ocean. Cold ocean water gives excessive radiocarbon dates, with examples in polar regions (R(t) + ΔR) of around 800–1,200 ^{14}C y (where ΔR = c. 400 to 800 ^{14}C y). The Mediterranean Sea has generally lower values of ΔR, but highly variable, estimated ΔR of 40 to 253 ^{14}C y. This is dependent upon natural variations in ocean concentrations, with perhaps some influence from different methodological approaches. No further correction is normally applied for the tropics and equator (ΔR ≈ 0 ^{14}C y).[18]

It is also recognized that marine reservoir corrections may be *time* dependent, and related to climatic changes over millennia,[18] but with uncertainty regarding detail. For example, Ascough *et al.* suggest that during the Younger Dryas (~12,000 years BP) ΔR may have been about 800–1,100 ^{14}C y for a location near Iceland, compared with 380 ^{14}C y today. Within the timeframe of a more recent Ice Age, it is feasible that ocean water upwelled to the surface as melting ice established cold deep ocean currents, thus leading to near-surface water with an excessive apparent carbon-14 age. The structure of the water column in the Mediterranean Sea at the end of the Ice Age is uncertain, with various possible scenarios. The surface water in the Mediterranean Sea may have been colder and less saline than today, and a stratified structure may have developed, similar to the current Black Sea. At the end of the Ice Age, this may have overturned as sea levels rose, or water with an excessive apparent carbon-14 age may have entered from the Atlantic. Such speculation highlights possible sources of error with carbon dating. There is also a sense that prior assumptions that are put into a model determine the outcome, whether biblical or secular.

Further errors in radiocarbon dating may arise in tidal zones, where fresh water and salt water meet, but not in a predictable manner. Fresh water entering a tidal estuary may be contaminated by limestone rock layers through which a river may flow, known as the *hard water effect*, and may give dates older than is warranted. Limestone is present in the Kaystros river catchment area. A study in Scandinavia found that where there has been a high diet of fish in hard water areas, then carbon-14 analysis of clay pots may be 2,000 years too old, thus significantly misplacing certain artefacts; in this example previously assigned to the Stone Age.[20] Material may also be moved laterally in a tidal estuary, or be reworked in sediment, and so specimens used in dating may not be truly representative. The calcium carbonate that forms shells may also interact with water as it is soluble, and so give false readings.[21] Further changes to the relative concentration of carbon-14 occur through the long-term solar cycle, a steady rise in atmospheric carbon dioxide from the Ice Age minimum, and decadal changes to geomagnetic fields.

Dating the Kaystros estuary

The necessity for such considerations widens the margin of error at great depth, and calls into question the reliability of carbon dating at earlier times where external corroborating evidence is lacking.[22] Archaeological and written records, from the Roman and Classical Greek periods, help to date the history of the Kaystros estuary back to at least 400 BC, and

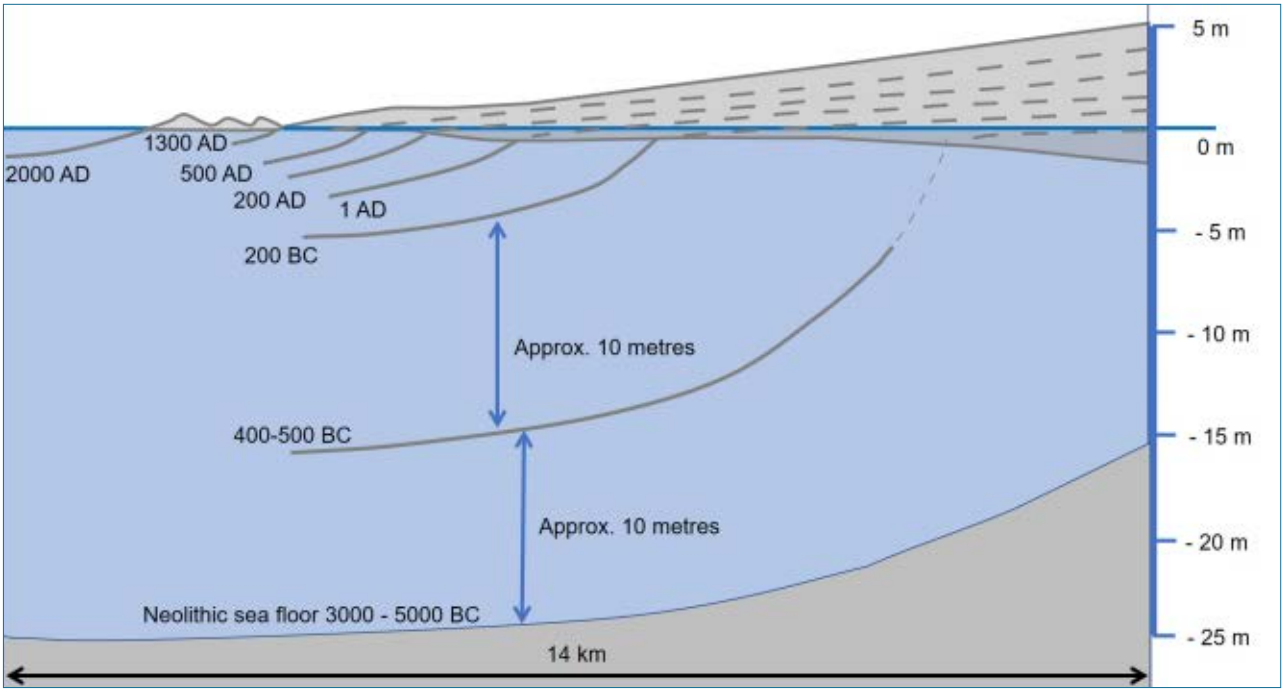

Figure 5. Cross section of the Kaystros river as it silted up. Note the discontinuity between the rate of sedimentation at the lowest levels c. 3000/5000 BC to c. 400/500 BC, and periods between c. 400/500 BC and c. 200 BC (adapted from Kraft *et al.*[8]—their figure 14).

this can be correlated with carbon dating to gain a reasonably accurate estimate, once corrected. A *marine reservoir effect* correction of 406 years was applied to marine calcium carbonate material from the Ephesus estuary by Kraft *et al.*, based upon measurements from nearby Lake Bafa near Miletus in the Maeander river estuary where a similar process of sedimentation has taken place. This correction brought the dating into alignment with those of terrestrial sources, and so is reasonably well correlated with archaeology and literature. But even so, there remains a margin of error. Kraft *et al.* offer an error margin for a *Cerastoderma edule* shell specimen from sediment taken from the *Feigengarten* excavation near the bottom of Mount Pion (from a depth of 3 m). This is dated to 89 BC, with a range of 166 BC to 9 BC based upon 67% confidence (1-Sigma). But at 2-Sigma confidence level (95%), this widens to 233 BC to AD 63.[6,8]

Core samples taken from the now shallow Lake Belevi are believed by secular research to extend back to 8000 BP, through a depth of up to 12 m, somewhat shallower than core samples in the harbour. With two core samples, a marine reservoir effect R(t) of 390 ± 85 ^{14}C y, with ΔR = 35 ± 70 ^{14}C y was applied; this corrected for the mollusc shell *Cerastoderma glaucum*.[9] The bottom of this core sample they suggest correlates with an Ice Age freshwater lake. From the perspective of the biblical model here it is likely that a great deal of sediment accumulated in the inland plain of the Kaystros valley during the recessional Flood period and Ice Age. This was as a result of excessive hydrological activity from rainfall and floods, and ongoing earthquake activity.

Also identified in the peat column from Lake Belevi is a layer of tephra from the Santorini eruption, dated to 1610 ± 15 BC, which offers a reasonable validation of the chronology of the higher core sample. Written records and archaeology increase confidence in dating in the Classical Greek period, but more fragmentary records and widening possible sources of error in carbon dating reduce confidence in the earliest timeframe of core samples.

Discussion and summary

The question here is how this evidence fits into the biblical timeframe, especially at the earliest times where there is secular departure from the biblical account. As noted above, the division of pre-history to Mesolithic, Neolithic, and Bronze Age is built upon the secular myth of an evolutionary progression, with the earliest biblical accounts of Genesis 1–11 rejected. The Table of Nations informs us who the first settlers were in Greece and Anatolia (Genesis 10:2–5). They were mostly the sons of Japheth:

> "Gomer, Magog, Madai, Javan, Tubal, Meshek and Tiras. The sons of Gomer: Ashkenaz, Riphath and Togarmah. The sons of Javan: Elishah, Tarshish, the Kittites and the Rodanites. (From these the maritime peoples spread out into their territories by their clans within their nations, each with its own language.)" (Genesis 10:2–5).

These migrating, extended families were likely contemporaneous with Abraham, travelling westwards, sometime

between 2400 and 1900 BC, after the dispersion from Babel. The account of Abraham, Isaac, and Jacob in Genesis reveals an extended family of semi-nomadic shepherds, but not one that ought to be dishonoured by the evolutionary progress myth. The early chapters of Genesis reveal a highly cultured people. Of course, the travelling people, with their animals, probably had to make do with tools and weapons of stone or bone, which is what archaeologists predominantly find in the earliest times. Metal worked implements may have been scarce. But with later settlement, as the needs of the more settled communities increased, metal working was re-started as sources of metal ore were identified and utilized. Scriptures tells us that knowledge of metal working had been present from the earliest times (Genesis 4:22).

The secular timeframe of earliest settlement in the Kaystros valley may then be contested from the biblical record, to around the late third century BC, with the end of the Flood occurring around 2400 BC according to the Masoretic Text. Carbon dating is reasonably accurate when it can be verified against known archaeological and written records, or known volcanic eruptions, but it becomes increasingly unreliable further back in time where there is little or no supporting evidence. Possible sources of error have been noted above, such as lack of equilibrium in radiocarbon presence between the atmosphere and ocean in the post-Flood and post-Ice Age period. By taking note of the biblical accounts of Genesis 10 and 11 there is potential for useful additional and independent information that may help to increase the accuracy of radiocarbon dating back to the third millennium BC, and so provide a revised methodology for determining ΔR.[23] The *marine reservoir effect* may have been significantly greater at the Ice Age/post-Ice Age transition period. More work needs to be conducted to piece together a model which is harmonious with the biblical account.

Bringing forward the time of first settlement to nearer 2000 BC in the Kaystros valley, with subsequent population growth, also helps to smooth out the sharp rate discontinuity in sedimentation identified by Kraft *et al.*, i.e. between the 10 m of sediment accumulated between 200 and 400 BC, and the 10 m over 2,600 years back to around 3000 BC. Overall, the Kaystros estuary provides a useful example of how flood plains have developed over time from the Ice Age to the present day, and this provides clues as to how other estuaries have changed through recent history.

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Instructions to Authors

JOURNAL OF CREATION is dedicated to upholding the authority of the 66 books of the Bible, especially in the area of origins. All our editors adhere to the Creation Ministries International (CMI) Statement of Faith and most papers will be designed to support this. Rarely, other papers may be accepted for publication on merit so that certain issues can be clarified. The views expressed in the papers are those of the authors and not necessarily those of CMI.

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NOTE: Papers prepared according to these instructions are more likely to be considered.

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